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UPPER MINNESOTA RIVER SUBBASINS STUDY (PUBLIC LAW 87-639) (DRAF--ETC(U)
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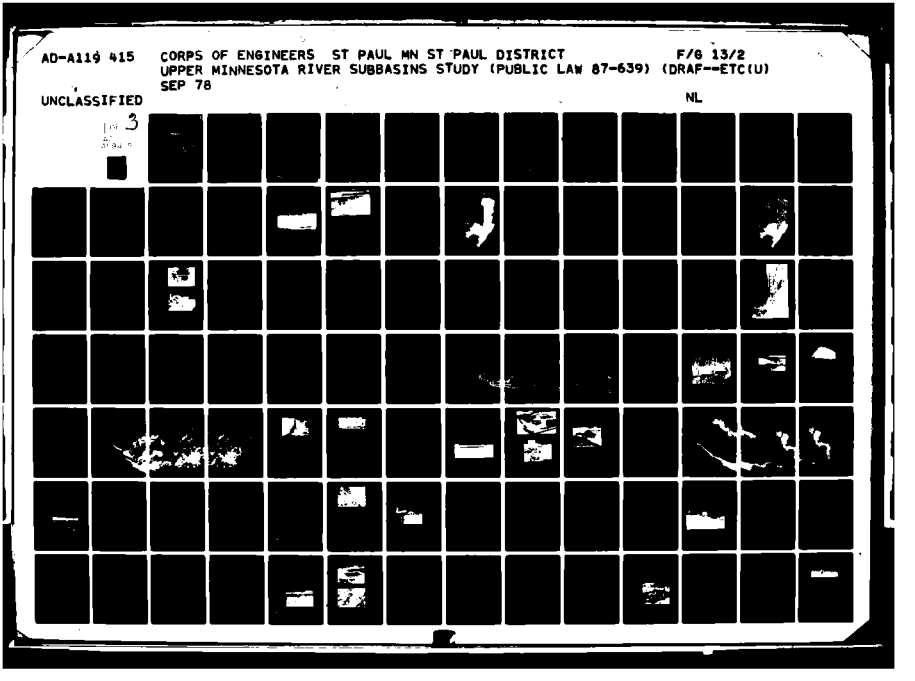

UPPER MINNESOTA RIVER SUBBASINS
STUDY (PUBLIC LAW 87-639)

# DRAFT

RECONNAISSANCE STAGE REPORT
(PLAN OF STUDY)





UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
AND
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS





SEPTEMBER 1978

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| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|---|---|
| 1. REPORT NUMBER | 2. GOVT ACCESSION NO. AD-A119415 | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle) UPPER MINNESOTA RIVER SUBBASINS STUDY (PUBLIC LAW 87-639) (DRAFT) RECONNAISSANCE STAGE REPORT (PLAN OF STUDY) | | 5. TYPE OF REPORT & PERIOD COVERED Draft plan of study |
| | | 6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s) | | 8. CONTRACT OR GRANT NUMBER(s) |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S.D.A. Soil Conservation Service 316 North Robert St. St. Paul, MN 55101 | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS |
| 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Paul 1135 USPO & Custom House St. Paul, MN 55101 | | 12. REPORT DATE September 1978 |
| | | 13. NUMBER OF PAGES 232 |
| 14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) | | 15. SECURITY CLASS. (of this report) Unclassified |
| | | 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Environmental assessment
Upper Mississippi River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The objectives of the study are to investigate alternatives for development of area water and related land resources, to solve flooding problems, and to investigate solutions to drainage, erosion and sedimentation, and water quality problems. The overall basin study will be in three stages: (1) Development of a plan of study to identify resource management problems; (2) Assessment of water and related land resource problems and needs, and (3) Analysis of alter-

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## STATEMENT OF FINDINGS

Problems of funding, manpower, and schedule requirements caused by the large scope and complexity of the study are evaluated in the following discussions of alternative schedules shown on pages 176 through 178. The 5½-year schedule on page 176 is an attempt to comply with current regulations on study length for both the SCS and Corps. This time constraint makes the resulting annual funding and manpower requirements in excess of the capability for both agencies. The schedule on page 177 adjusts the overall length of schedule to comply with fiscal year 1979 agency budget limitations (assumes Corps is funded $400,000 based on House and Senate conference report and SCS is funded $694,000). Although this schedule would only extend the study approximately 6 months, the resulting annual funding and manpower requirements for other fiscal years are in excess of both agencies' capabilities including contracting.

The schedule on page 178 (also see attached table) is based on the projected maximum manpower available at the two agencies. This schedule projects an 8-year study period and provides for an alternatives report at the end of the first year of study. The alternatives report will display the first iteration of alternative components based on gross appraisals of readily available data. A preliminary feasibility (Stage II) report will present results of the second iteration of alternative land and water resource management plans midway in the study. Draft and final feasibility reports will display a final iteration of alternative plans including NED, EQ, and the selected plan of improvement at the end of the 8-year study. The above study approach accomplishes investigations for the entire study area.

A different study approach, recognizing limitations of funding and manpower, could maintain continuity of hydrologic and economic investigations on the overall study area while conducting interim studies on the

five individual river subbasins as interrelationships are resolved (see attached table). These interim studies could be started about 1 year apart and each completed within 2 to 3 years, followed by a final 2-year report at the end of the 10-year study.

Some of the advantages and disadvantages apparent from comparison of the total 8-year study approach and the interim study approach are tabulated below.

Total Study Approach

Advantages

1. Optimum construction scheduling for distribution of benefits

Disadvantages

1. First report on feasibility of potential project in 8 years.
2. Any changes in scale of development caused by changes in hydrology and economics within the 8-year study would cause change and delay in project.
3. Local interests do not favor longer studies before first construction.

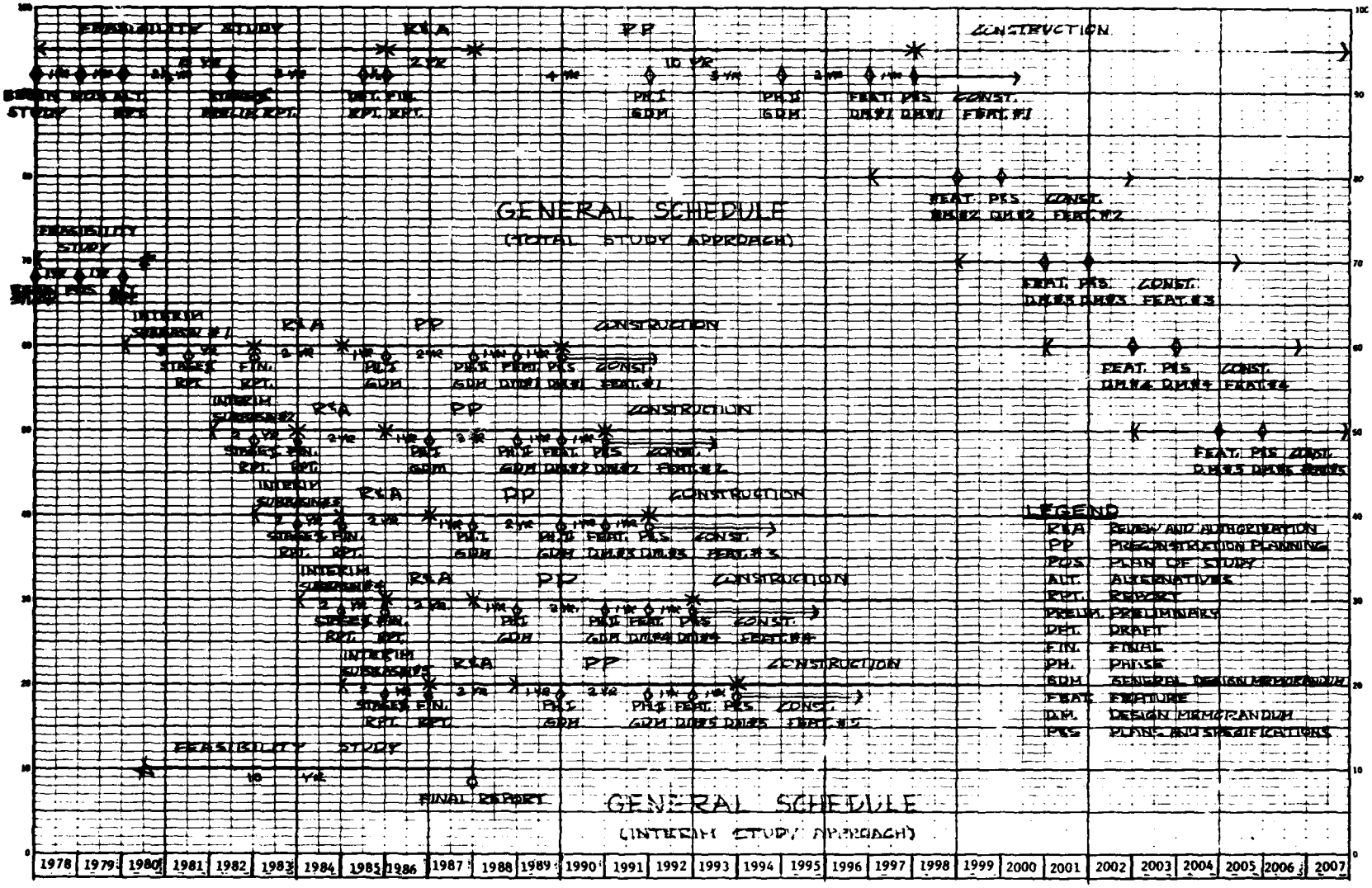
Interim Study Approach

Advantages

1. Timely submission of study results, authorization, pre-construction planning, and construction.
2. Benefit of damages prevented in frequent flooding areas actually realized sooner.
3. Local interests favor shorter study and earlier construction.
4. Construction of feature No. 1 could begin 10 years earlier.
5. Review of hydrologic-economic base for scale of development is repeated.
6. Public involvement and study management would be more readily conducted.
7. Better use of planning staffs, uniform annual budget, and more uniform sequencing of construction.

Disadvantages

1. Study and construction sequence could use majority of monetary benefits for first in-place construction leaving limited amount for downstream improvements.


GENERAL SCHEDULE
(TOTAL STUDY APPROACH)
GENERAL SCHEDULE
(INTERIM STUDY APPROACH)
FEASIBILITY STUDY
CONSTRUCTION
FEAT. PLS. CONST.
FEAT. #1
FEAT. #2
FEAT. #3
INTERIM SURVEY #1
INTERIM SURVEY #2
INTERIM SURVEY #3
INTERIM SURVEY #4
FINAL REPORT
LEGEND
R&A REVIEW AND AUTHORIZATION
PP PRECONSTRUCTION PLANNING
PDS PLAN OF STUDY
ALT. ALTERNATIVES
RPT. REPORT
PRELIM. PRELIMINARY
DFT. DRAFT
FIN. FINAL
PH. PHASE
GDM GENERAL DESIGN MEMORANDUM
FEAT. FEATURE
D.M. DESIGN MEMORANDUM
PLS PLANS AND SPECIFICATIONS
1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007

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APPENDIXES

# UPPER MINNESOTA RIVER SUBBASINS STUDY (PUBLIC LAW 87-639)

## RECONNAISSANCE STAGE REPORT (PLAN OF STUDY)

### INTRODUCTION

In June 1972, the Upper Mississippi River Basin Coordinating Committee submitted the completed Upper Mississippi River Comprehensive Basin Study to the Water Resources Council. The study presented a framework program for development and management of water and related land resources in the Upper Mississippi River basin.

Included in the report was a summary of concerns recommended for further study. In the Minnesota River basin, these concerns included water quality, flood and sediment damage, water supply, commercial navigation, recreation opportunity, and environmental preservation. The proposal suggested that a regional or river basin plan, based on guidelines established by the Water Resources Council, be coordinated by a river basin commission responsible for focusing on middle-term (next 10 to 15 years) needs and desires.

The Southern Minnesota Rivers Basin Board was created by the Minnesota Statutes, Chapter 705, Laws of 1971, to coordinate resource planning in the basin. The U.S. Department of Agriculture participated in a Type IV river basin study under the authority of section 6 of Public Law 83-566 authorizing the Secretary of Agriculture, in cooperation with other Federal, State, and local agencies to make investigations and surveys of the watersheds of rivers and other waterways as a basis for development of coordinated programs. The study was completed by the Southern Minnesota Rivers Basin Board in February 1977.

The Secretary of Agriculture designated the Soil Conservation Service to provide leadership in carrying out the department's responsibilities in conducting the study. The Forest Service and the Economic Research Service participated under provisions of a Memorandum of Understanding dated 15 April 1968 (RB-2, Rev., dated 6 May 1968).

The Southern Minnesota Rivers Basin Board recommended that a joint study by the Department of the Army and the Department of Agriculture, authorized by Congress under Public Law 87-639, be used to aid in solving the problems in study area II of the overall Type IV river basin study.

## AUTHORITY

The Governor of Minnesota asked Congress to authorize the Corps of Engineers and the Soil Conservation Service under Public Law 87-639 to conduct an implementation study for the area. The following resolution authorizing the study was passed by Congress in December 1975.

> "Resolved by the Committee on Public Works and Transportation of the House of Representatives, United States, that the Secretary of the Army and the Secretary of Agriculture are hereby authorized and directed to make joint investigations and surveys, as provided by Public Law 87-639, of the Redwood, Cottonwood, Yellow Medicine, Lac Qui Parle, and Yellow Bank Rivers' sub-basins of the Minnesota River Basin and to prepare joint reports on such investigations and surveys setting forth their recommendations for the installation of works of improvement needed for flood prevention or the conservation, development, utilization and disposal of water, and for flood control and allied purposes. Such joint reports shall be prepared and submitted in compliance with the provisions of the public law cited herein."

## STUDY OBJECTIVES

The objectives of this study are to:

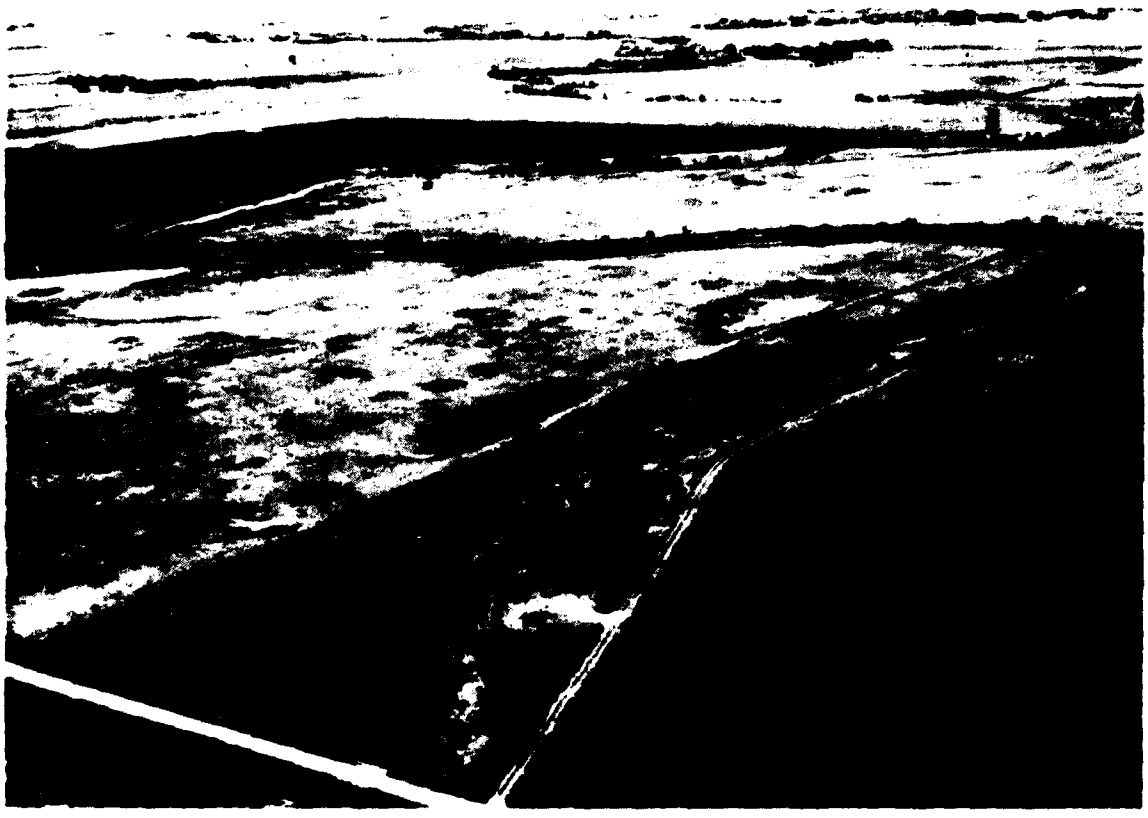
- Further investigate and clarify alternatives for orderly development of water and related land resources of the study area.

- Solve the flooding problems including crossover flooding between adjoining watersheds.

- Investigate solutions to drainage, erosion and sedimentation, and water quality problems.

The study will consider beneficial and adverse impacts of alternatives to improve recreation, fish and wildlife resources, and other environmental features peculiar to the basin. The following photographs are views of the Yellow Medicine and Mud Creek subbasins, respectively.

Typical floodplain along the Yellow Medicine River, April 1976



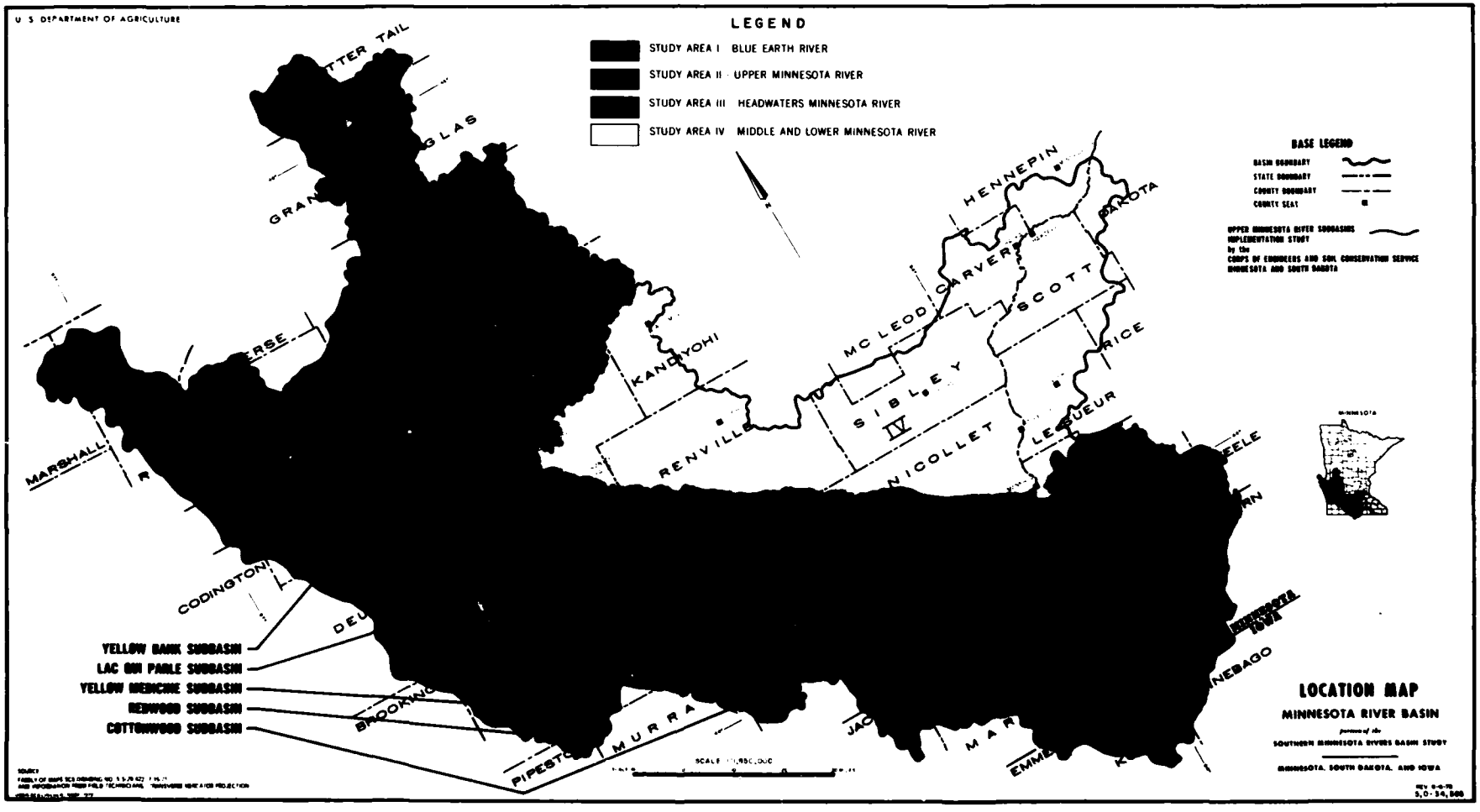
Mud Creek subbasin, looking southwest toward the distant Coteau des Prairies, June 1972

## RESOURCES AND ECONOMY

### LOCATION

The Minnesota River basin is part of the Upper Mississippi Water Resources Region. The Little Minnesota River (headwaters of the Minnesota River) drains the eastern slope of the Dakota foothills in South Dakota, approximately 30 miles west of the Minnesota border, and flows southeast to Big Stone Lake. From Big Stone Lake the Minnesota River flows southeast to Mankato, Minnesota, where it turns and flows northeast to its confluence with the Mississippi River in St. Paul-Minneapolis, Minnesota.

The Minnesota River basin, 16,770 square miles (10,732,000 acres), includes all or parts of 37 counties in Minnesota, 6 in South Dakota, and 3 in Iowa. The authorized study area comprises 4,183.8 square miles (2,677,632 acres) which is 33 percent of the Minnesota River basin and includes all or part of nine counties in Minnesota and four counties in South Dakota. The following figure shows the location of the study area. The study area, divided according to State and county, is described in the table on page 7.


U. S. DEPARTMENT OF AGRICULTURE
LEGEND
STUDY AREA I BLUE EARTH RIVER
STUDY AREA II UPPER MINNESOTA RIVER
STUDY AREA III HEADWATERS MINNESOTA RIVER
STUDY AREA IV MIDDLE AND LOWER MINNESOTA RIVER
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
COUNTY SEAT
UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY by the CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE MINNESOTA AND SOUTH DAKOTA
HENNEPIN
DAKOTA
CARVER
SCOTT
MC LEOD
SIBLEY
RICE
LE SUEUR
NICOLLET
RENVILLE
KANDIYOHI
MARSHALL
CODINGTON
YELLOW BANK SUBBASIN
LAC QUI PARLE SUBBASIN
YELLOW MEDICINE SUBBASIN
REDWOOD SUBBASIN
COTTONWOOD SUBBASIN
MINNESOTA
IOWA
LOCATION MAP
MINNESOTA RIVER BASIN
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA

Study area by State and county

| State | County | County area (square miles) | Study area (square miles) | Percent of county in study area |
|---|---|---|---|---|
| Minnesota | Brown | 618 | 269.7 | 44 |
| | Cottonwood | 645 | 249.6 | 39 |
| | Lac qui Parle | 775 | 570.8 | 74 |
| | Lincoln | 541 | 457.1 | 84 |
| | Lyon | 716 | 688.8 | 96 |
| | Murray | 721 | 110.8 | 15 |
| | Pipestone | 464 | 25.7 | 6 |
| | Redwood | 874 | 670.0 | 77 |
| | Yellow Medicine | 758 | 453.3 | 60 |
| Total | | | 3,495.8 | |
| South Dakota | Brookings | 809 | 23.8 | 3 |
| | Codington | 766 | 23.0 | 3 |
| | Deuel | 644 | 334.0 | 52 |
| | Grant | 687 | 307.2 | 45 |
| Total | | | 688.0 | |
| Total study area | | | 4,183.8 | |

SOURCE: 1967 Conservation Needs Inventory, Soil Conservation Service, U.S. Department of Agriculture.

## CLIMATE

The study area has a continental climate and is subject to frequent influxes of continental polar air throughout the year. Cold waves are usually of the boreal type - rushing south over the area from the continental arctic regions. Occasional periods of high temperature occur in the summer when warm air pushes north from the Gulf of Mexico and the southwestern United States. When Pacific Ocean air masses move across the western United States, they produce comparatively mild, dry weather in all seasons.

Mean annual temperatures range from 42° F to 45° F from west to east. The July mean temperature is 74° F; the January mean temperature is 13° F. The freeze-free (air temperature greater than 32° F) growing season generally starts about the second week of May and ends during the first week of October. The eastern area in Brown County has the longest growing season - approximately 140 days. The northernmost part of the area in South Dakota has approximately 120 freeze-free days. The soil freezes about the first week of December and thaws about mid-April. Average maximum freeze depth in the area is from 3 to 4 feet, exclusive of forested regions where the freezing depth is usually shallower.

Mean annual precipitation ranges from 28 inches in Brown County, Minnesota, to 22 inches in the South Dakota portion of the study area. Normal rainfall during the crop season ranges from 18 inches in the eastern part of the study area to 14 inches in South Dakota. Approximately two-thirds of the annual precipitation occurs during the crop season.

Seasonal snowfall averages 40 inches in the study area near the border and accounts for 30 percent of total precipitation. Snow cover of 1 inch or more over the basin averages 90 days annually.

Moderate or worse drought conditions are expected at least once in 4 years except in the western watersheds where they occur about once in 3 years. Severe or extreme drought conditions occur on the average of once in 8 years, except in the southwest where they occur about once in 6 years. Generally, the more severe droughts persist or recur several years in succession.

Average annual lake evaporation is 35 inches. Annual pan evaporation ranges from 40 to 48 inches a year. The actual daily evapotranspiration (evaporation from land and plant surfaces) averages about 0.15 inch daily during June, July, and August. Row crops average approximately 20 inches of evapotranspiration a year. However, the average annual potential evapotranspiration, assuming adequate soil moisture at all times, is nearly 24 inches.

Thunderstorm winds are a frequent cause of damage to property and crops throughout the area. The annual frequency during the growing season is about once in 45 days. Eighty percent or more of these storms occur during the heavier rainfall months - May through September. Tornadoes occur most frequently between May and July; they are most prevalent in June. Damaging local windstorms, tornadoes, hail, and heavy rains occur with the stronger and more well-developed thunderstorms.

## GEOLOGY AND PHYSIOGRAPHY

The study area is within the "western lake section" central lowland province of the interior plains physical division of the United States. This section is characterized by young glaciated plains, moraines, lakes, and lacustrine plains.

The surface materials and features are a product of recent glaciation. Glacial materials cover most of the sediment and ancient bedrock in the study area but ancient bedrock and younger sedimentary rock are exposed in a few places. The bedrock is among the oldest rock known on earth, dating back over 3 billion years.

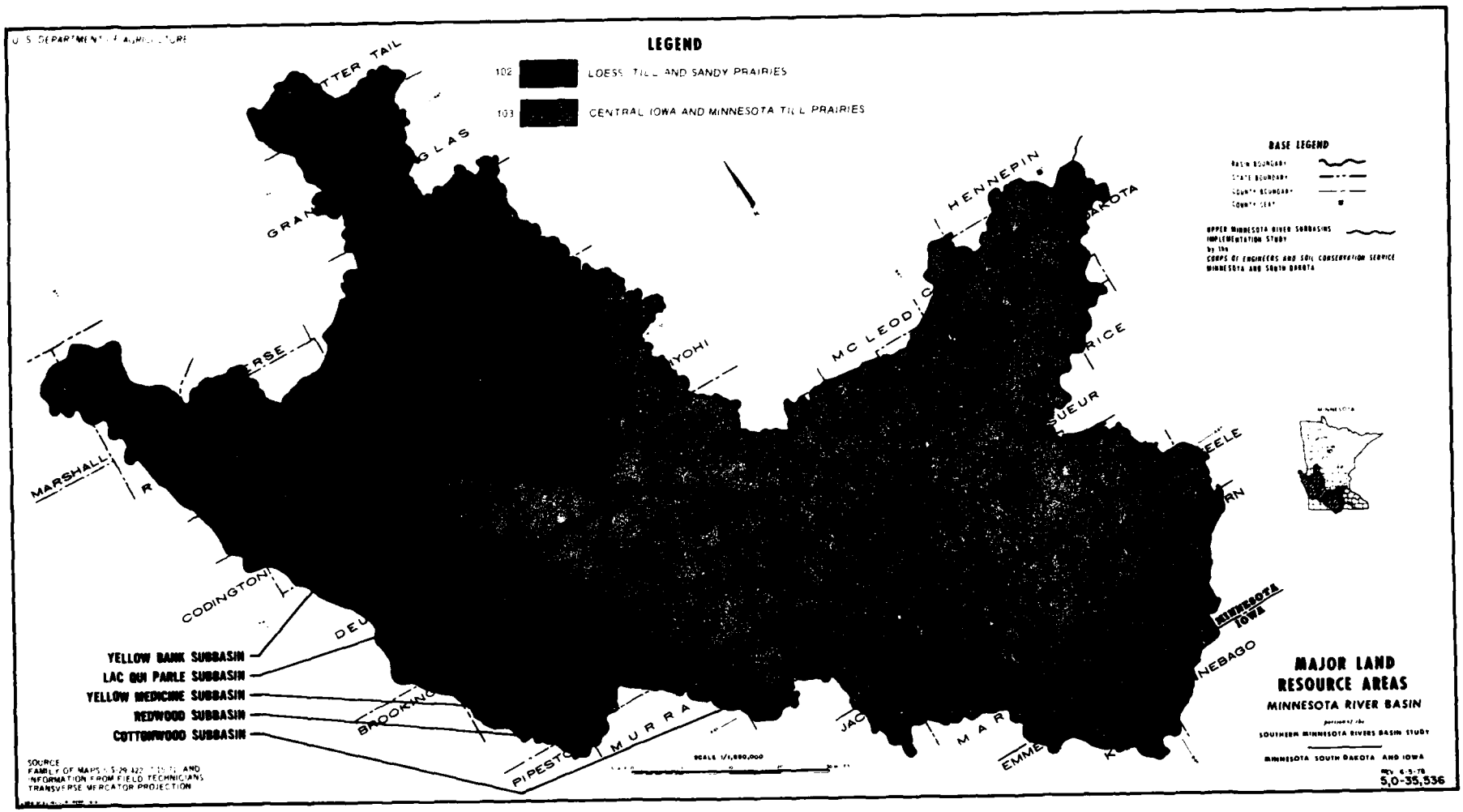
The topography over the northeast two-thirds of the study area is flat to gently undulating. Subdued hills and ridges border the outer limits on the south and southwest. Watershed divides over much of the area are indistinct. The Coteau des Prairies sloping escarpment rises about 2,000 feet along the southwest side of the study area with the highest elevation in Grant County, South Dakota. The outlet of the Minnesota River at the study area boundary has an elevation of 775 feet, which accounts for 1,225 feet of total relief.

The natural drainage pattern was established by the rivers and valleys formed by glacial meltwaters. The present low gradient streams occupy these older systems practically without modification. The present drainage network is poorly defined except for the major rivers. Considerable areas have no outlet. Interior watershed divides are indistinct and crossover flooding is a common occurrence. Channel construction over the last half centry has established a man-made drainage network over the area. Large areas do not have major channels with adequate capacity.

## LAND RESOURCE AREAS

The Minnesota River basin is within the Central Feed Grains and Livestock Region. This land resource region is further broken down into land resource areas (LRA) - broad geographic areas having similar soil, climatic, geologic, vegetative, and topographic features.[1] The basin is located within portions of two major land resource areas: 102 - Loess, Till and Sandy Prairies; and 103 - Central Iowa and Minnesota Till Prairies. The land resource areas are shown on the following figure and described on page 12.

(1) Minnesota River Basin Report, Chapter II, Section D, page II-4.


U S DEPARTMENT OF AGRICULTURE
LEGEND
102 LOESS TILL AND SANDY PRAIRIES
103 CENTRAL IOWA AND MINNESOTA TILL PRAIRIES
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
COUNTY SEAT
UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY by the CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE MINNESOTA AND SOUTH DAKOTA
TTER TAIL
GRAN
G LAS
ERSE
MARSHALL
CODINGTON
DE
BROOKIN
PIPESTO
MURRA
YOHI
MC LEOD
HENNEPIN
RICE
SUEUR
EELE
RN
NEBAGO
JAC
MAR
EMME
K
MINNESOTA
IOWA
YELLOW BANK SUBBASIN
LAC QUI PARLE SUBBASIN
YELLOW MEDICINE SUBBASIN
REDWOOD SUBBASIN
COTTONWOOD SUBBASIN
SOURCE
FARMLY OF MAPS
INFORMATION FROM FIELD TECHNICIANS
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SCALE 1/1,000,000
MAJOR LAND RESOURCE AREAS
MINNESOTA RIVER BASIN
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA SOUTH DAKOTA AND IOWA
REV. 4-3-78
5,0-35,536

The majority of the western half of the basin is in LRA 102 (Loess, Till, and Sandy Prairies). Chernozem soils developed on calcareous loam till are dominant. Topography is mostly undulating, but ranges from nearly level to hilly. Typical soils are Barnes and Langhei in the uplands, Flom and Parnell in the lowlands, and Arvilla and Maddock in the outwash. Nearly all land is cultivated, mostly with row crops and small grains. Water and wind erosion are serious problems and drainage is a problem on wet cropland soils.

The central and eastern portions of the basin are in LRA 103 (Central Iowa and Minnesota Till Prairies). The central portion consists of Brunizem and Humic Gley soils developed on calcareous loam and clay loam till. Topography ranges from nearly level to hilly, but is mostly gently undulating. Nearly all of the area is under cultivation with row crops being the most common crops. The eastern edge of the basin consists of gray-brown Podzolic or gray-brown Podzolic-Brunizem intergrade soils developed from calcareous loam and clay loam till. Topography in this area ranges from undulating to steep. Nearly all of the land is cultivated, mostly with row crops, hay, and small grains. Erosion is the most serious problem on rolling cropland. Lack of drainage associated with poorly drained cropland soils is also a problem. Typical soils are Clarion, Lester, and Hayden in the uplands; Webster, Dundas, and Glencoe in the lowlands; and Estherville, Hubbard, and Burnsville in the outwash.

## LAND USE DISTRIBUTION

Land use varies within the study area. The total 2,677,632 acres represents 25 percent of the total 10.7 million acres in the Minnesota River basin. The 1974 agricultural land use pattern is shown in the following table.

*Study area land use, 1974*[1]

| Use | Acres | Percent |
|---|---|---|
| Cropland | 2,142,120 | 80 |
| Corn[2] | (835,426) | (39) |
| Soybeans | (556,951) | (26) |
| Oats | (214,212) | (10) |
| Pasture in rotation | (171,370) | (8) |
| Alfalfa hay | (128,527) | (6) |
| Small grains[3] | (107,106) | (5) |
| Idle[4] | (64,264) | (3) |
| Other | (64,264) | (3) |
| Pastureland | 240,980 | 9 |
| Forest land | 53,550 | 2 |
| Other land | 133,882 | 5 |
| Noninventory | 107,100 | 4 |
| Total | 2,677,632 | 100 |

(1) Adjusted 1967 Conservation Needs Inventory data, Soil Conservation Service.

(2) Corn includes corn for both grain and silage. Approximately 90 percent of corn grown is harvested as grain and 10 percent is harvested as silage.

(3) Small grains are mainly spring wheat, barley, and flaxseed.

(4) Idle cropland has decreased significantly since 1967.

The largest land use is cropland. Corn and soybeans, the major crops, account for 65 percent of the cropland category. Idle cropland has decreased significantly since 1967. Higher prices for crops, coupled with the farmers' desire to make each acre economically productive, have resulted in "fence-to-fence" production. The removal of the U.S. Department of Agriculture program requirements of conserving base acres, along with expiration of many crop adjustment programs and soil bank agreements, has contributed to this shift.

Most of the forest land is located along natural watercourses; however, small acreages of forest occur on farmsteads and steep slopes. Trees remain where it is not profitable or possible to produce agricultural crops. Forests occur on 2 percent of the land area, and commercial forest accounts for 93 percent of the total forest land. Commercial forest land is forest land which does or can produce crops of industrial wood and is not withdrawn from timber use by statute or administrative regulation.

## WATER RESOURCES

Approximately 35,000 acres of surface storage is available in lakes and wetlands in the study area. Average annual runoff varies from 3 inches in the southeast to 1 inch in the northwest. The limiting season for water availability is in late fall and winter with 70 percent of floods occurring in the spring. An estimated 900 miles of streams are in the study area. The following photographs show typical lake and river scenes. Data on study area lakes and rivers are given in the tables on pages 16 and 17.

Typical lake scene in study area, July 1972

Yellow Medicine River, Normania Township,
Yellow Medicine County, 1976

Lake improvement investigations, general information

| County | Lake name | Pub. 25 I.D. Number | Division of waters (acres) | Planimetered area and year | Type outlet | Meandered water body? | Location Section | Twp | Range | Wetland type | Maximum depth (feet) | Management Fish | Marg. | Game | Littoral area (Fish lake only) | Wildlife management area | Public access | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minnesota | | | | | | | | | | | | | | | | | | |
| Brown | Boys | 8-96 | 160 | 362.4 - 1947 | Creek | Yes | 11-14 | 109 | 34 | VA | | | X | | | | | |
| | Sleepy Eye | 8-45 | 290 | 424.5 - 1947 | Ditch | Yes | 19,20 29,30 | 110 | 32 | V | 9 | X | | | 100 percent 2.4 mi. shore | | | Dam at outlet |
| Cottonwood | Bean | 17-54 | 141 | 189.77 - 1948 | Overflow | Yes | 14 | 107 | 38 | VA | | | X | | | | Yes. county | GLS-1948 |
| | Double | 17-56 | 227 | 245.92 - 1948 | Creek | Yes | 22,23 26 | 107 | 38 | VA | | | X | | | | Yes, county | GLS-1948 |
| | Long | 17-48 | 262 | 260 - 1948 | Stream | Yes | 22,23 26,27 | 106 | 38 | IV | 5 | | | X | | | Yes, county | GLS-1948 |
| Lac qui Parle | Lac qui Parle | 37-46 | 4,625/ 8,400 | 5,589 | Minnesota River | Yes | | 118-120 | 42-43 | V | 14 | X | | | 100 percent | | Yes(5) | Also in Chippewa Swift Lake Survey 1956 |
| | Pegg | 37-224 | 133 | | CD 2 | No | 4 | 118 | 46 | IV | | | | X | | | | |
| | Salt (Rosabel) | 37-229 | 259 (312) | 60 - 1964 | None | Yes | 5,8 | 117 | 46 | III | 0.4 | | | X | | | | Also in South Dakota GLS 1964 |
| Lincoln | Benton | 41-43 | 2,875 | 2,857.1 - 1956 | Creek | Yes | | 104, 110 | 44, 45 | VA | 9 | | X | | 100 percent | | Yes(2) | FLS-1956 |
| | Hendricks | 41-110 | 684 (1,634) | 669.8 | Creek | Yes | 18,19 23,24 | 112 | 46, 47 | V | 10 | X | | | | | Yes | 950 acres in South Dakota |
| | Shoakatan | 41-89 | 1,043 | 995 LS map - 1957 | | Yes | 22,24 26-28 | 111 | 46 | V | 12 | X | | | 100 percent | | | Resort SE end |
| Lyon | Cottonwood | 42-14 | 383 | 376 - 1967 | Ditch | Yes | 4,5 8,9 | 113 | 40 | VA | 8 | | X | | | | Yes, city park | GLS-1967 |
| | Goose | 42-93 | 151 | 154 - Blue book | | Yes | 29,32 33 | 111 | 43 | VA | | | X | | | | Yes, State | |
| | School Grove | 42-2 | 348 | | | Yes | 35,36 25,26,31 | 113 | 39-40 | VA | 11 | | X | | | | Yes, State | |
| | West Twin | 42-74 | 237 | | | Yes | 29-32 | 109 | 43 | VA | 10 | | X | | | | Yes, county | GLS-1948 |
| Yellow Medicine | Miedd | 87-61 | 148 | 171 - 1967 | Channel | No | 23,26 | 114 | 41 | IV | 5 | | | X | | | | GLS-1967 |
| | Spellman | 87-60) | 300 | 162 - 1967 | Ditch | Yes | 16,22,23 | 114 | 41 | IV | 5 | | | X | | | | GLS-1967 |
| | Spellman | 87-60) | | 110 - 1967 | Channel | Yes | 22,23 | 114 | 41 | VA | 7.5 | | X | | | | | GLS-1967 |
| South Dakota | | | | | | | | | | | | | | | | | | |
| Brookings | Hendricks | 41-110 | | | | | | | | | | X | | | | | | |
| | Oak | (C) | | | | | | | | | | | X | | | | | |
| Deuel | Cochrane | (A) | | | | | | | | | | X | | | | | | |

GLS - Game Lake Survey (DNR)
FLS - Fish Lake Survey

Data on study area rivers

| River basin | Drainage area (square miles) | Flow (cfs) Maximum | Minimum | Average | Runoff (inches per year) | Flow duration: Discharge (cfs) | Flow duration: Percent of time discharge equal to or greater | Low flow (cfs) 7-day | Low flow (cfs) 10-year | U.S. Geological Survey water quality data |
|---|---|---|---|---|---|---|---|---|---|---|
| Yellow Bank River near Odessa, Minnesota | 398 | 6,970 | 0 | 56.9 | 1.94 | 1.0<br>9.6 | 91.3<br>48.2 | 0.1 | | Currently taking specific conductance, temperature, and sediment readings |
| Lac qui Parle River near Lac qui Parle, Minnesota | 983 | 17,100 | 0 | 119 | 1.64 | 0.20<br>13.0 | 86.6<br>52.3 | | 0.1 | |
| South Branch Yellow Medicine River at Minneota, Minnesota | 111 | 4,430 | 0 | 20.3 | 2.48 | 0.10<br>1.70 | 81.3<br>53.2 | | | |
| Yellow Medicine River near Granite Falls, Minnesota | 653 | 17,200 | 0 | 102 | 2.12 | 2.20<br>12.0 | 91.0<br>52.9 | | 0.4 | |
| Redwood River at Marshall, Minnesota | 307 | 5,590 | 0 | 45.1 | 1.99 | 1.30<br>6.10 | 91.9<br>55.8 | | 0.1 | |
| Redwood River near Redwood Falls, Minnesota | 697 | 19,700 | 0 | 98.8 | 1.92 | 1.50<br>17.0 | 92.3<br>51.0 | | 0.3 | |
| Cottonwood River near New Ulm, Minnesota | 1,280 | 28,700 | 0.5 | 267 | 2.83 | 10.0<br>51.0 | 90.5<br>51.6 | | 2.5 | Water quality monitoring discontinued |

Groundwater is available from glacial sand and gravel aquifers and sedimentary bedrock aquifers. More than half of the study area supplies are from cretaceous bedrock aquifers which provide nondependable, low yielding, poor quality water supplies.

## WATER QUALITY

The water from the glacial deposits is very hard, contains high iron concentration, and requires treatment for public water supply. Water samples from the northwestern portion of the area range in hardness from 400 mg/l (milligrams per liter) to more than 1,000 mg/l. Dissolved solids as high as 2,000 mg/l are found, with iron as high as 10 mg/l. In many areas, the iron content of wells is 10 times the 0.3-mg/l maximum content recommended for drinking water.

The Office of Water Data Coordination, U.S. Department of the Interior, lists 11 U.S. Geological Survey surface water data collecting gaging stations and 1 water quality collection location in the study area. Hydrologic atlases covering the study area have been published by the U.S. Geological Survey in cooperation with the Minnesota Department of Natural Resources, Division of Waters. Data on quantitative yields, natural quality, use suitability, quantitative withdrawals, and consumption from ground and surface sources are contained in the atlases. For the study area, all the rivers, except the Cottonwood River, have had periods of no flow and periods of relatively poor water quality.

The Minnesota Pollution Control Agency has published a Minnesota River basin plan which divides the basin into segments and classifies the segments as to water quality. Approximately one-half of the basin is classed as "effluent limited" and the other half as "water quality limited." The water quality limited area, unlike the effluent

limited areas, will probably not meet relevant water quality standards, even after application of the best feasible technology for industries and secondary treatment facilities for municipalities as defined in the 1972 Federal Water Pollution Control Act Amendments. More advanced treatment for municipalities and industries, as well as nonpoint source pollution control, appears necessary.

## FISH, WATERFOWL, AND WILDLIFE

Originally, most of the study area was a vast expanse of midgrass and tallgrass prairie with extensive lake and wetland acres. Woodlands occurred along the rivers and streams and surrounded many of the lakes and wetlands. The predominant wildlife species included buffalo, antelope, elk, deer, beaver, otter, mink, muskrats, various species of waterfowl and shorebirds, grouse, prairie chicken, squirrels, and rabbits.

The conversion of prairie and wetlands to agricultural uses has produced habitat conditions unlike those observed by early settlers. Nearly 90 percent of the land is now cropland or pastureland. Native prairie occurs only as small, isolated remnant patches. Forested acres along the rivers and tributaries, combined with woodlots, farmsteads, and field windbreaks, total 53,550 acres, or 2 percent of the total land area. Less than 40,000 acres of wetlands remain. This shift in land use has eliminated buffalo and elk from the area and replaced them with species more adaptable to farmland habitat. A small remnant herd of antelope exists in the South Dakota portion of the area.

The introduced ring-necked pheasant and Hungarian partridge and the native squirrels, rabbits, waterfowl, furbearers, and white-tailed deer are the dominant animal species. Upland game bird and mammal populations have steadily declined since their peaks in the middle 1950's. The number

of cottontails and jack rabbits has decreased. Intensified agriculture has shifted from crop rotation, which included small grain and hay, to continuous row cropping on more acres each year. Harvest efficiency has increased, leaving little waste for winter food. Considerable natural cover has been converted in the process.

August roadside pheasant censuses (1948-1974) show high populations of ring-necked pheasants between 1955 and 1958 and steadily declining numbers since 1962 (see the figure on page 64). Because of the shortage of winter food and cover and inadequate distribution of nesting habitat, the pheasant breeding population is only about 15 percent of previous levels.

The Hungarian partridge was never as abundant as the pheasant. The downward trend of this species appears to have been halted and counts have increased in recent years.

The mourning dove, a migratory upland bird, inhabits the study area when food is abundant and conditions are ideal. Its numbers have increased and the species appears to be doing well. Doves are protected from hunting, but show good potential to supply hunting opportunities.

White-tailed deer habitat is primarily restricted to the wooded river bottoms and lands associated with them. Farmlands provide abundant food; thus, winter starvation losses are minimal. The quantity and distribution of forest and brush cover are the limiting factors. The highest deer concentrations occur where croplands are marginal and dissected by windbreaks, woodlots, or forest and brush areas. Very high local densities are attained with this fringe effect. However, most of the forests in the study area are mature stands and moderately heavily grazed, leaving little or no undergrowth and ground vegetation. This produces only fair quality habitat. White-tailed deer and duck harvest data are shown in the following table.

Deer and duck harvest per square mile, upper Minnesota River subbasins[1]

| Year | Number harvested per square mile | |
|---|---|---|
| | Deer | Duck |
| 1967 | 0.4 | 10.9[illegible] |
| 1968 | 0.27 | [illegible].72 |
| 1969 | 0.24 | 11.52 |
| 1970 | 0.40 | 1[illegible].7 |
| 1971 | (Season closed statewide) | |
| 1972 | 0.31 | |
| 1973 | 0.44 | |
| 1974 | 0.25 | |

(1) From the Minnesota Department of Natural Resources Project Quarterlys.

Habitat quantity and quality are the major factors which control populations. When either declines, disease, starvation, predation, and winter take larger numbers of individuals, successful reproduction decreases, and total populations drop. Adequate food and cover are especially critical during winter and reproduction and rearing periods.

Excellent habitat is provided on approximately 31,600 upland acres which are included within State and Federal management areas, generally in association with wetlands. Windbreaks, roadside ditches, and scattered natural areas provide the ramining upland habitat.

The study area contains a number of wetlands. Along with wetlands in surrounding States and Canada, they comprise the major waterfowl production area for the entire midsection of the United States. The most common game species of waterfowl include mallard, blue- and green-winged teal, ring-necked duck, wood duck, Canada goose, and snow goose. Numerous other species of waterfowl and shorebirds are

found throughout the study area. Wetland and associated nesting and brooding habitat is but a fraction of former acreages. Dry and drained basins total nearly 30,000 acres. Croplands have long provided adequate food supplies. The major impact from agriculture has been wetland drainage. Major efforts to preserve and enhance the remaining wetlands are needed. Duck harvests have gradually increased primarily because of increased hunting days per season per hunter.

Some species have not been able to adjust to the environmental change. Rare or endangered species that may be seen in the study area include the bald eagle, golden eagle, greater sandhill crane, pileated woodpecker, American osprey, American peregrine falcon, arctic peregrine falcon, and whooping crane. The status of these and other species is periodically reviewed and updated by State wildlife agencies and the U.S. Fish and Wildlife Service.

Fish lakes total 20,938 acres in the study area. The following table illustrates the numbers of these lakes.

Fish lakes and marginal fish lakes (10 acres or larger)(1)

| Item | Amount |
|---|---|
| Fish lakes | |
| Number | 7 |
| Acres | 7,109 |
| Marginal fish lakes | |
| Number | 42 |
| Acres | 13,829 |
| Total | |
| Number | 49 |
| Acres | 20,938 |

(1) Minnesota Department of Natural Resources Lake Inventory Classifications.

Many of these lakes are shallow, fertile, and classified as rough fish lakes. Lake game fish include northern pike, largemouth bass, walleye, crappie, and sunfish. Of the total annual catch by weight, about 30 percent are northern pike and about 20 percent are crappie and sunfish. Bullheads are well suited for winter survival in shallow waters. Although considered a rough fish in many areas, bullheads account for about 25 percent of the total harvest by weight each year.

Rivers and streams provide 900 miles of riverine habitat throughout the study area. Most of the rivers and streams provide marginal warm-water habitat and sustain mostly rough fish populations. Brook and brown trout occur in the few remaining cold water reaches. Smallmouth bass, rock bass, and crappies inhabit the better warm water reaches.

Carp and other rough fish have invaded most of the streams and many of the lakes. Quality of fish habitat has decreased with increased erosion and siltation and accelerated eutrophication of water bodies by nutrient rich runoff from agricultural lands. Urban and industrial pollution is also a growing contributor to the degradation.

## RECREATION RESOURCES

Outdoor recreation opportunities are many and varied. A summary of recreation activities is presented in the following table.

Estimated activity occasions occurring on an average weekend day (1975)

| Activity | Number of occasions |
|---|---|
| Swimming | 39,598 |
| Golf | 4,401 |
| Tennis | 2,898 |
| Outdoor games | 68,169 |
| Walking for pleasure | 11,301 |
| Bicycling | 50,198 |
| Horseback riding | 3,660 |
| Trap and target shooting | 1,113 |
| Fishing | 9,741 |
| Boating | 3,552 |
| Canoeing | 1,973 |
| Water-skiing | 9,204 |
| Sailing | 574 |
| Camping | 7,887 |
| Hiking | 845 |
| Picnicking | 13,633 |
| Nature walks | 16,577 |
| Snowmobiling | 14,506 |
| Snow skiing | 675 |
| Small-game hunting | 5,232 |
| Large-game hunting | 10,273 |
| Waterfowl hunting | 3,495 |

Data on recreation facilities are provided in the Minnesota Department of Natural Resources 1974 SCORP (State Comprehensive Outdoor Recreation Plan) and the recently completed inventory of private facilities by the National Association of Conservation Districts. Most facilities are not adequate to meet the present demand when acceptable space standards are applied. The following photograph shows a public picnic area.

Picnic area at Corps of Engineers dam on the Lac qui Parle River

## CULTURAL, ARCHEOLOGICAL AND HISTORICAL RESOURCES

In a historical sense, the heart of Minnesota lies in the river valley which gave the State its name. Since glacial times, this valley has witnessed man's struggle to survive and control his surroundings. About 10,000 years ago, primitive hunters camped on the edge of melting sheets of ice in pursuit of the mammoth and giant bison. Brown's Valley Man left his bones and weapons to be found by later inhabitants. Over a period of thousands of years, more sophisticated cultures gradually developed in this central river valley. The ancestors of the modern Indian built permanent villages, raised crops, hunted, fought and built mounds for their dead along its bluffs. The dawn of recorded history found the Dakota or Sioux Indians well established on the borders of the river.

Among the more significant prehistoric sites in or near the study area are:

- Brown's Valley Man (6000-5000 B.C.), Browns Valley, Traverse County, Minnesota.
- Pederson Site (c. 1000 B.C.-1600 A.D.), Lake Benton, Lincoln County, Minnesota.
- Pipestone National Monument (prehistoric to present), Pipestone County, Minnesota.
- Fox Lake (500 A.D.), near Sherburn, Martin County, Minnesota.
- Mountain Lake (c. 1000 B.C.-1600 A.D.), Cottonwood County, Minnesota.
- Jeffers Petroglyphs (3000 B.C.-1700 A.D.), Cottonwood County, Minnesota.
- Cambria (1200 A.D.), Blue Earth County, Minnesota.

Concentrations of prehistoric sites are in the Big Stone Lake area, in the Blue Earth River drainage, and along the lower Minnesota River from Henderson downstream to the river's mouth. Many of the prehistoric sites are on the National Register of Historic Places. In addition, the following Historic Districts are listed in the National Register:

- Lac qui Parle Mission and Village Historic District, Chippewa and Lac qui Parle Counties, Minnesota.
- Upper Sioux Agency Historic District, Yellow Medicine County, Minnesota.
- Lower Sioux Agency Historic District, Redwood County, Minnesota.
- Lake Benton Historic District, Chippewa County.

Written records of the Minnesota River basin extend back to 1700 A.D. when Pierre Le Sueur, a French trader and explorer, built a fort called L'Hillier on the Blue Earth River near modern Mankato. Jonathan Carver, a New Englander, wintered on the St. Peter's (Minnesota) River near modern Carver, Minnesota, in 1767. During the American Revolution, Peter Pond, a Yankee trader, canoed up this river to trade with the Sioux tribe. In 1805, Lieutenant Zebulon Pike bought the land at the junction of the St. Peter's and Mississippi Rivers as a site for a military post. In 1820, United States troops began to build a stone fort on the bluff overlooking these rivers.

For the next 30 years, the St. Peter's River valley remained the home of many bands of Sioux Indians, fur traders, and their descendants. Fort Renville, a fur post, was operated at the widening of the river called Lac qui Parle from about 1826 to 1845. Nearby was built the Lac qui Parle Mission which sought to educate and christianize the Sioux. Later, missions were built downstream at Hazelwood and Traverse des Sioux, Minnesota. From 1847 to 1862, hundreds of wooden Red River carts laden

with buffalo hides from Pembina, North Dakota, on the Canadian border put deep ruts in the river bottoms and made the Red River Trail which terminated at St. Paul.

The treaties of Traverse des Sioux and Mendota were signed in 1851. By their terms, the resident Sioux Indians ceded millions of acres of rich land between the Mississippi and Big Sioux Rivers to the white man. These documents restricted the Indians to a narrow reservation on the upper Minnesota River and opened the ceded land to white settlers. Fort Ridgely was later built on the river near Fairfax in Nicollet County, Minnesota; the Lower and Upper Sioux Agencies were built near Morton and Granite Falls, Minnesota. At these locations, efforts were made to teach the ways of the white men to the Indians. Nearby was erected the elaborate stone "castle" of Joseph R. Brown, a noted frontiersman and public figure.

By 1872, over 2,000 miles of railroads had been laid in Minnesota, allowing development of communities on the rich prairie lands. With the railroads, communities were no longer limited to locate along navigable streams. The developing transportation and communication network spread the word of fertile soils in the Minnesota River valley quickly and brought many immigrant families to the area. By 1870, the population in the Minnesota River basin had grown to over 85,000 persons. At the turn of the century, the population exceeded a quarter of a million persons. This flood of immigration abruptly changed the economic structure of the area from subsistence agriculture, lumbering, and remnants of the fur industry to a commercial agricultural economy with exports of wheat, oats, corn, barley, and potatoes.

With the close of the Sioux and Civil Wars, settlers changed the valley into farmland. Railroads replaced steamboats as the mode of transportation and the frontier was supplanted by farms, villages, and towns.

Archeological and historical sites in the study area are shown in the following table.

Archeological and historical sites in the study area

| Item | Number |
|---|---|
| Archeological sites | |
| Mounds and burial sites | 56 |
| Habitations and villages | 28 |
| Other(1) | 6 |
| Total | 90 |
| Historical sites | |
| Forts and missions | 22 |
| Historic houses | 6 |
| Indian conflicts | 3 |
| Other(2) | 27 |
| Total | 58 |
| Total sites | 148 |

(1) Includes sites of bison kills, petroglyphs, rock alignments, dance rings, and undetermined status.

(2) Includes sites of geology markers, historic trails, ethnic settlements, folklore markers, historical districts, and architectural sites not included in the historic houses category.

## UNIQUE AND SCENIC AREAS

Certain areas and sites in the study area exhibit unique characteristics and, whether natural or historic, provide residents and visitors with a special kind of aesthetic experience or insight into the region's past. In the basin, 51 unique natural and scenic sites have been inventoried (see the following table).

Unique natural and scenic areas in the study area[1]

| Area | Number |
|---|---|
| Waterfall | 2 |
| Rapids/whitewater | 2 |
| Beach | 2 |
| Land form | 5 |
| Prairie remnant | 4 |
| Scenic timber | 2 |
| Rare flora | 2 |
| Natural and scientific area | 4 |
| Fish habitat | 5 |
| Game habitat | 14 |
| Viewpoint or vista | 4 |
| Historic significance | 5 |
| Total | 51 |

(1) From Minnesota Department of Natural Resources document, "Natural and Historic Areas of Minnesota," 1971.

## IRRIGATION

At present, irrigation is not a significant practice in the study area. Approximately 1,270 acres is being irrigated. Another 8,000 acres has potential for irrigation.

## AIR QUALITY

Generally, air quality in the study area is good. Some localized wind erosion could be a problem where airborne soil acts as an irritant. This occurs where topsoils are sandy or very light textured, especially during drought years when plant cover is inadequate. Land treatment practices are important in controlling wind erosion.

## HUMAN RESOURCES

The study area's population characteristics and trends are similar to most of rural America. Over the past two decades, the total population has remained stable with decreases in the rural population offset by increases in the larger urban centers. Greater economic opportunity has motivated younger persons to move from farms and small towns to larger towns and cities. This migration has left a slightly older population in many rural areas.

The population decreased from 131,000 in 1950 to 122,000 in 1970. Of this total, the urban population increased from 33,000 to 43,000, the rural nonfarm population decreased from 38,000 to 36,000, and the rural farm population decreased from 60,000 to 43,000. The education level of persons 25 years of age and older is slightly lower than the State average of 47 percent completing high school and 12 percent completing college.

Family and per capita incomes in the study area lag behind the State averages of $11,098 and $3,052, respectively. The 1970 family mean income, $8,693, and per capita income, $2,414, are 21 percent lower than the State averages. Approximately the same proportion of families in the study area is classified as middle income ($5,000 to $15,000) as compared to the State average; but a higher proportion falls into the low income groups, and a lower proportion is in the high income groups.

About 37 percent of the 1970 population was part of the study area's labor force. Unemployed workers accounted for 3.6 percent of the labor force which contributed to the outmigration from the study area. Employment by industrial classification is 24 percent agricultural, 30 percent manufacturing, 21 percent wholesale and retail trade, and 25 percent services.

## DEVELOPMENT AND ECONOMY

Opportunities for development in the study area are determined by natural resources, environment, and existing and future economic conditions. Continued economic growth and higher levels of living are goals of resource planning. Successful resource planning requires projection of economic conditions and their accompanying resource demands. The need for resource development is then evaluated by comparing these future resource demands with available resources.

Land use in the study area is shown in the table on page 13. Development potential for the land uses is presented in chapter 3 of the Type IV study.

A well-developed transportation network connects major service centers and provides farm-to-market routes throughout the Minnesota River basin. Although only a few miles of interstate highway have been built in the basin, other Federal and State roads provide excellent intrabasin routes and trunk lines to the Minneapolis-St. Paul, Sioux Falls, South Dakota, and Fargo, North Dakota-Moorhead, Minnesota, metropolitan areas. Current and proposed interstate routes nearly surround the basin and provide quick, easy access to areas outside the basin.

Four major rail lines operate in the basin and provide freight service to most towns. The larger towns receive daily service while smaller, more remote areas receive only weekly or triweekly service. Besides rail freight, much commerce is carried by numerous trucking companies operating within the basin.

Four intercity bus lines provide passenger service to all the larger towns and many small towns in the basin. Major airline service is provided only to Mankato and Fairmont. However, easy access is provided to the Twin Cities International Airport.

# LAND AND WATER RESOURCES PROBLEMS AND NEEDS

## INTRODUCTION

The problems and needs discussed below were identified during meetings, interviews, and discussions held throughout the study area with local citizens, policy committees, and technical field personnel. Problems identified, in order of importance, are:

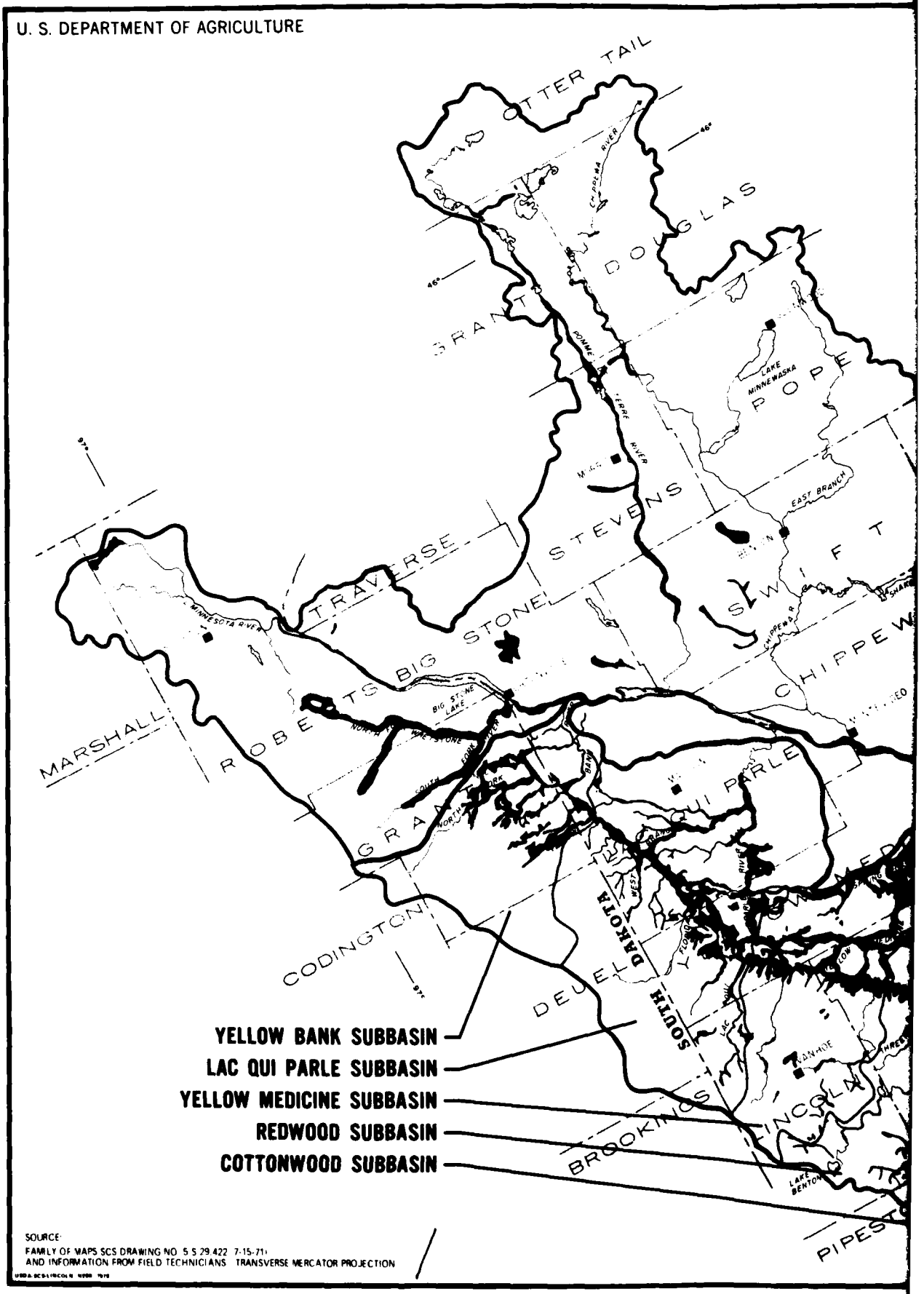
1. Flooding, including crossover flooding between adjoining watersheds which requires group solution.
2. Inadequate cropland drainage.
3. Erosion and sedimentation.
4. Pollution.
5. Inadequate fish and wildlife habitat.
6. Lack of recreation opportunities.

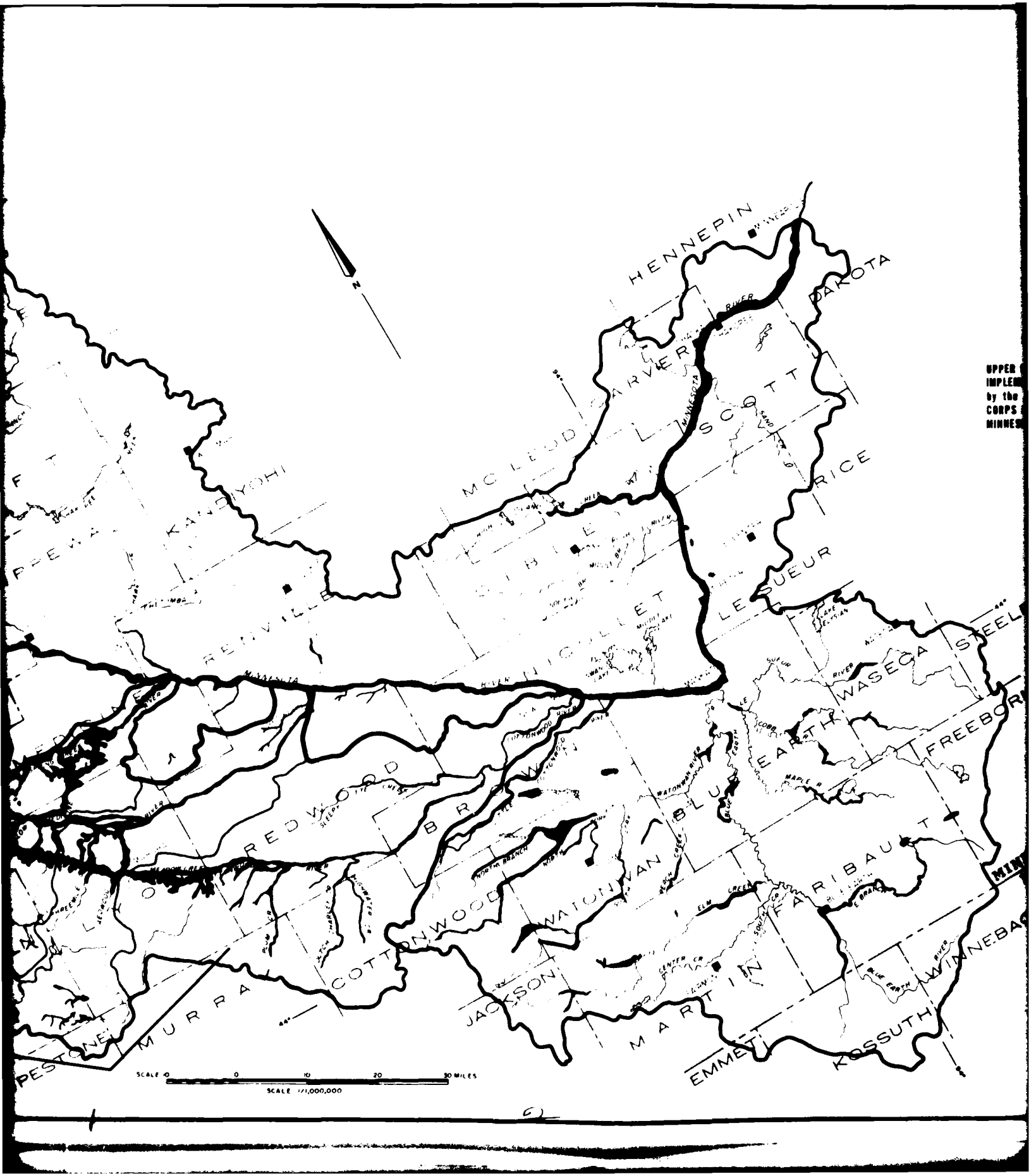
These land and water resource problems are caused by man's lack of understanding of the capabilities of the resources and his desire to use the resources for maximum economic gains.

In recent years, the restoration and conservation of these land and water resources have become major concerns. Since the 1930's, damaging practices in the use of land and water have been recognized and identified. Physical capabilities of land and water were studied. Land-users have generally accepted the conservation concepts and their applications. However, even with all of the research that is involved and the energy and moneys being spent in the field of resource conservation, significant problems still remain.

## FLOODING

Flooding is one of the primary concerns along the Minnesota River and elsewhere in the study area. Cropland and pasture flooding occur on 302,000 acres in the study area. Flooding occurs on an additional 195,100 acres along the Minnesota River. The flooded areas are shown on the following figure.


U. S. DEPARTMENT OF AGRICULTURE
OTTER TAIL
DOUGLAS
GRANT
POPE
STEVENS
SWIFT
TRAVERSE
BIG STONE
CHIPPEWA
MARSHALL
ROBERTS
GRANT
LAC QUI PARLE
CODINGTON
DEUEL
SOUTH DAKOTA
BROOKINGS
LINCOLN
PIPESTONE
MINNESOTA RIVER
LAKE MINNEWASKA
EAST BRANCH
BIG STONE LAKE
YELLOW BANK SUBBASIN
LAC QUI PARLE SUBBASIN
YELLOW MEDICINE SUBBASIN
REDWOOD SUBBASIN
COTTONWOOD SUBBASIN
SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5 S 29,422 7-15-71
AND INFORMATION FROM FIELD TECHNICIANS TRANSVERSE MERCATOR PROJECTION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DAKOTA
CARVER
SCOTT
RICE
LE SUEUR
WASECA
FREEBORN
MARTIN
FARIBAULT
JACKSON
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WATONWAN
BLUE EARTH
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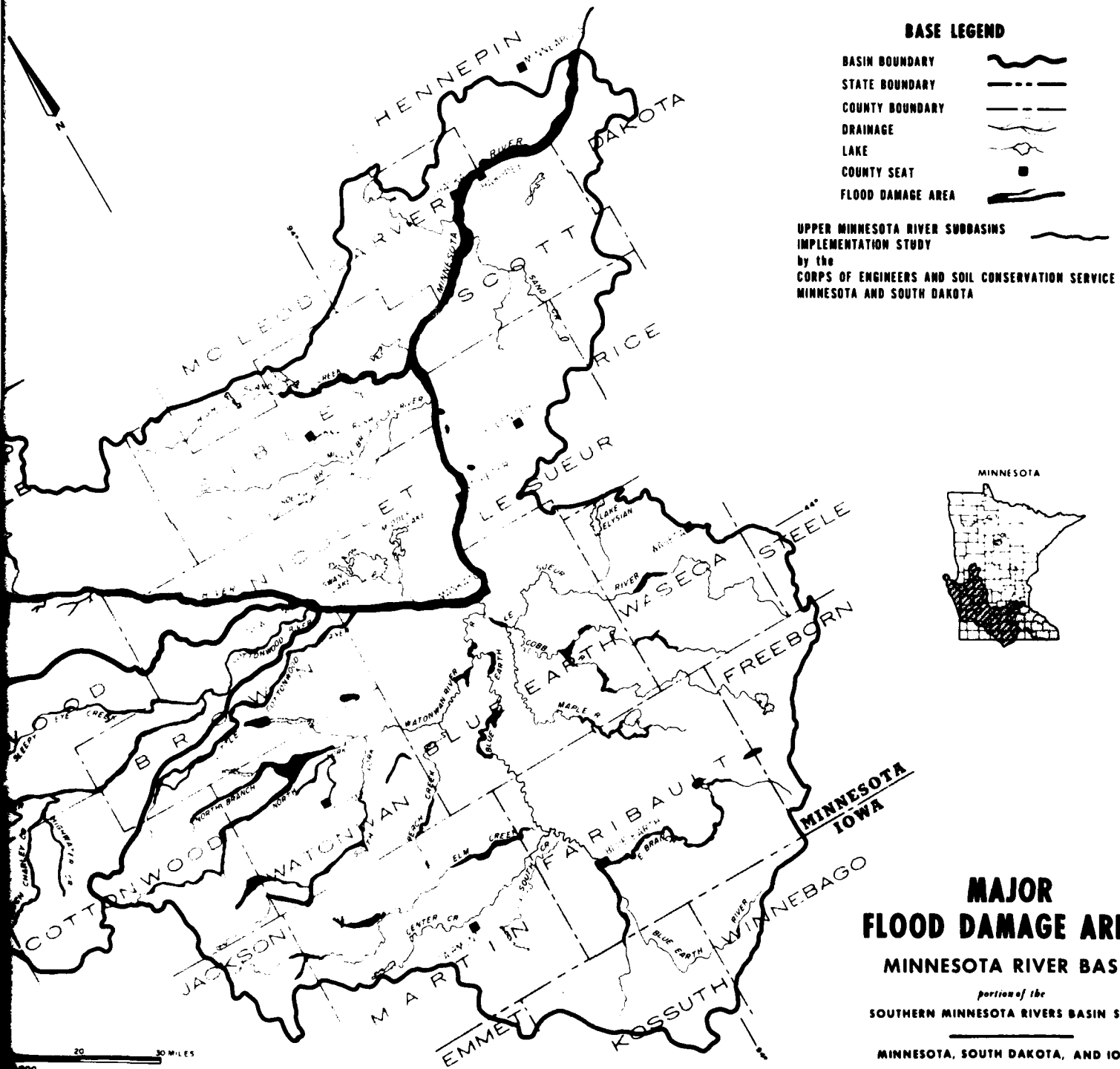



## BASE LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE
- COUNTY SEAT
- FLOOD DAMAGE AREA

UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY
by the
CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE
MINNESOTA AND SOUTH DAKOTA




# MAJOR FLOOD DAMAGE AREAS

## MINNESOTA RIVER BASIN

*portion of the*

SOUTHERN MINNESOTA RIVERS BASIN STUDY

MINNESOTA, SOUTH DAKOTA, AND IOWA

REV 6-1-78
5,S-34,384

Five principal tributaries enter the Minnesota River from the south between Big Stone Lake and New Ulm, Minnesota. These tributaries make up the following subbasins: Yellow Bank, Lac qui Parle, Yellow Medicine, Redwood, and Big Cottonwood. The following table gives the land use in the floodplain and the total area.

Floodplain land use[1]

| Subbasin | Acres in floodplain | | | | |
|---|---|---|---|---|---|
| | Total | Cropland | Pasture | Woodland | Other |
| Yellow Bank | 15,300 | 11,300 | 2,900 | 800 | 300 |
| Lac qui Parle | 97,000 | 62,100 | 21,300 | 7,800 | 5,800 |
| Yellow Medicine | 96,700 | 69,600 | 14,500 | 3,900 | 8,700 |
| Redwood | 46,400 | 23,200 | 19,500 | 900 | 2,800 |
| Big Cottonwood | 46,600 | 30,800 | 6,000 | 5,100 | 4,700 |
| Total | 302,000 | 197,000 | 64,200 | 18,500 | 22,300 |

(1) All figures are rounded.

Topography is flat in the lower two-thirds of the subbasins. Study results indicate the subbasins are inseparable, their problems and needs are interrelated, and a large portion of flood reduction benefits are from adjoining subbasins. Average annual damages are estimated in the following table.

Average annual flood damages

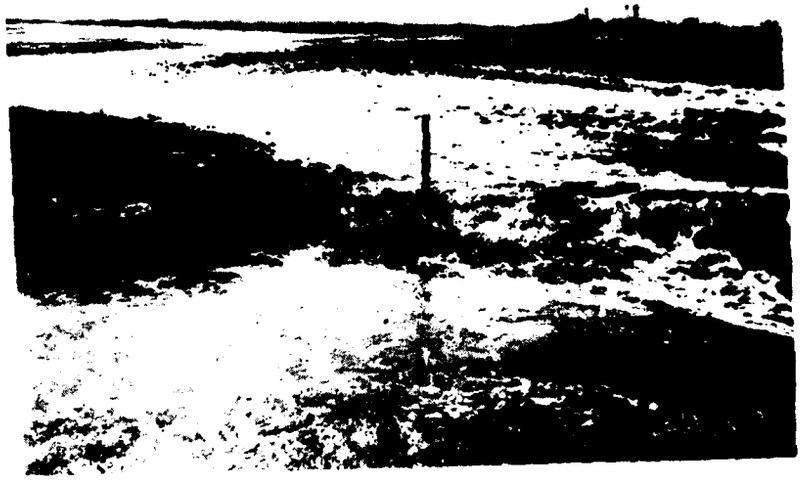
| Subbasin | Damages | | | | | |
|---|---|---|---|---|---|---|
| | Crop and pasture | Other agricultural | Road and bridge | Urban | Indirect | Total |
| Yellow Bank | $160,900 | $18,800 | $15,700 | $300 | $20,300 | $216,000 |
| Lac qui Parle | 1,253,800 | 155,400 | 35,300 | 9,100 | 147,400 | 1,601,000 |
| Yellow Medicine | 1,491,300 | 163,400 | 27,800 | 5,700 | 170,800 | 1,859,000 |
| Redwood | 708,000 | 81,900 | 20,600 | 7,700[1] | 82,800 | 901,000 |
| Big Cottonwood | 979,500 | 59,300 | 12,800 | 11,200 | 107,200 | 1,170,000 |
| Total | 4,593,500 | 478,800 | 112,200 | 34,000 | 528,500 | 5,747,000 |
| Percent of total damage | 80 | 8 | 2 | 1 | 9 | 100 |

(1) This report assumed no urban damages in Marshall, Minnesota, because of Corps of Engineers flood control project.

Many locations in the study area have had flooding from adjoining watersheds, referred to as "crossover flooding". This flooding, as shown on the figure on page 34, forms a floodway nearly parallel to the Minnesota River. The following photograph shows a locally constructed rubble levee to control this flooding. Determining the amount and frequency of flood flow caused by crossover flooding is of primary importance in determining possible solutions and effects on all subbasins. Each of these subbasins has interrelated flood problems that will have to be solved as a group. Attempts to solve the flood problems individually by Public Law 566 watersheds have had limited success because of the interrelated flood problems.

Existing rubble levee constructed to prevent crossover flooding from the Yellow Bank to the Lac qui Parle River basin, December 1967.

Flooding occurs annually on some of the smaller streams. Major floods on the larger rivers occur 1 or 2 years out of 10 and show the greatest frequency of occurrence in April. The following photographs show flooding in the study area.



Cropland flooding in the study area - water was 2 feet deep at one stage

Flooding of highways and roads is a major problem in the study area.

## DRAINAGE

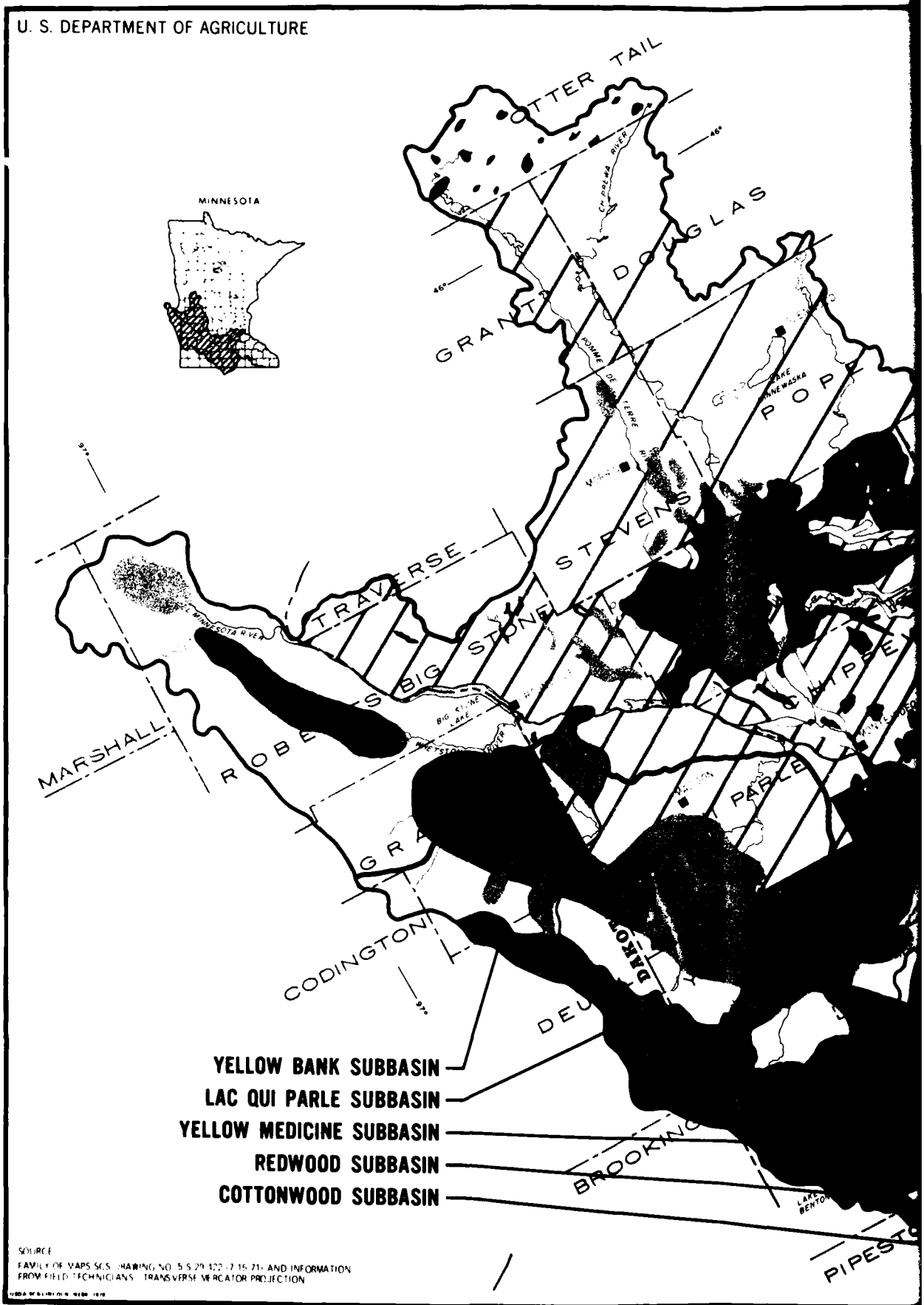
Agriculturally, excess water becomes a problem when it interferes with land preparation, tillage, development of plants, and harvest operations on croplands. These problems contribute to reductions in crop yield, increased production costs, and lower quality of products. Environmentally, wetlands are necessary for waterfowl production and beneficial to wildlife species requiring wetland habitat. Wetlands also provide some natural protection from floods by retarding storm-waters and storing sediment.

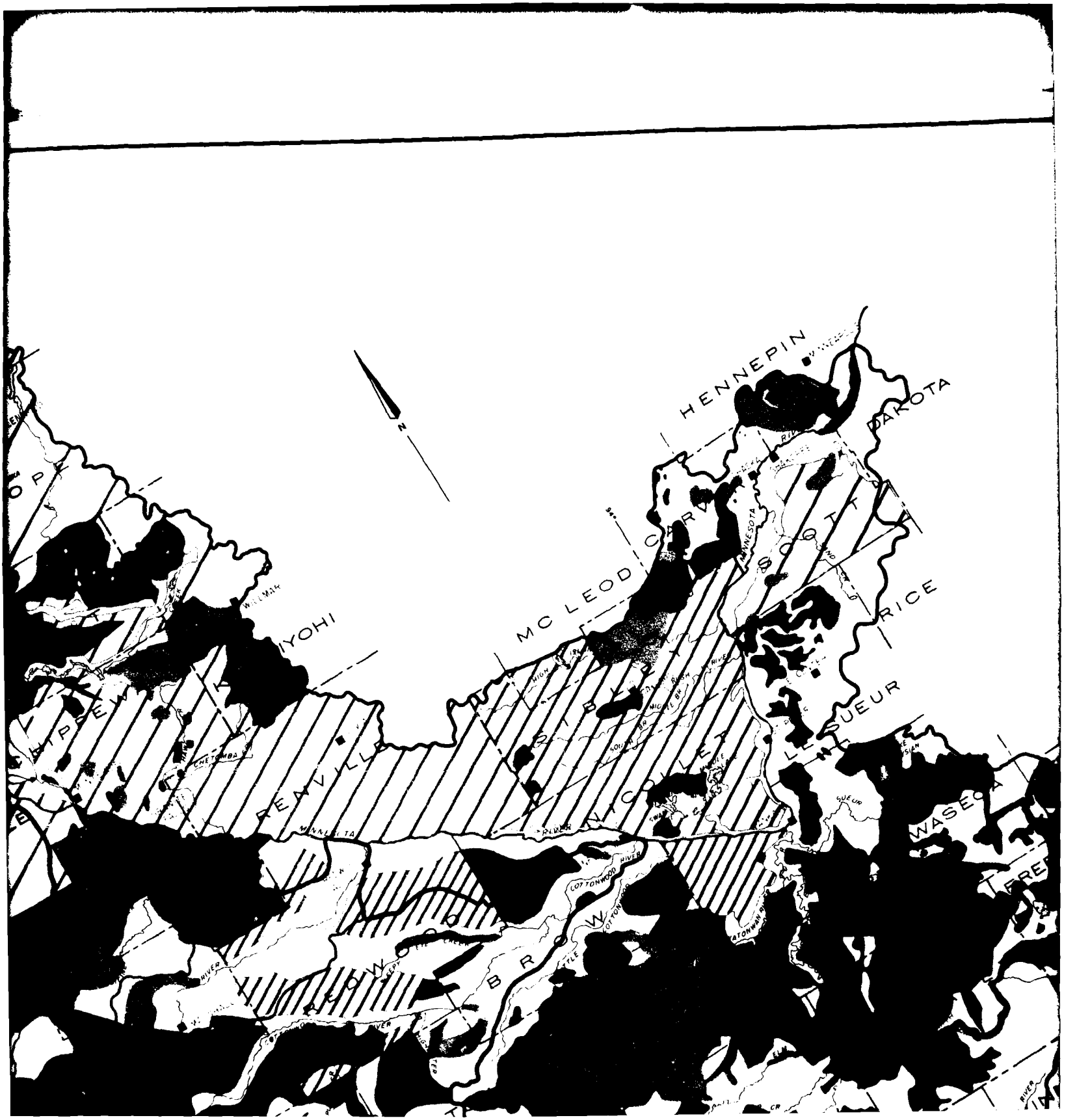
Agricultural drainage problems are caused by excess surface and/or subsurface water. Surface drainage problems exist generally where the natural stream drainage pattern is undeveloped. In many problem areas, surface and subsurface drainage systems are interdependent.

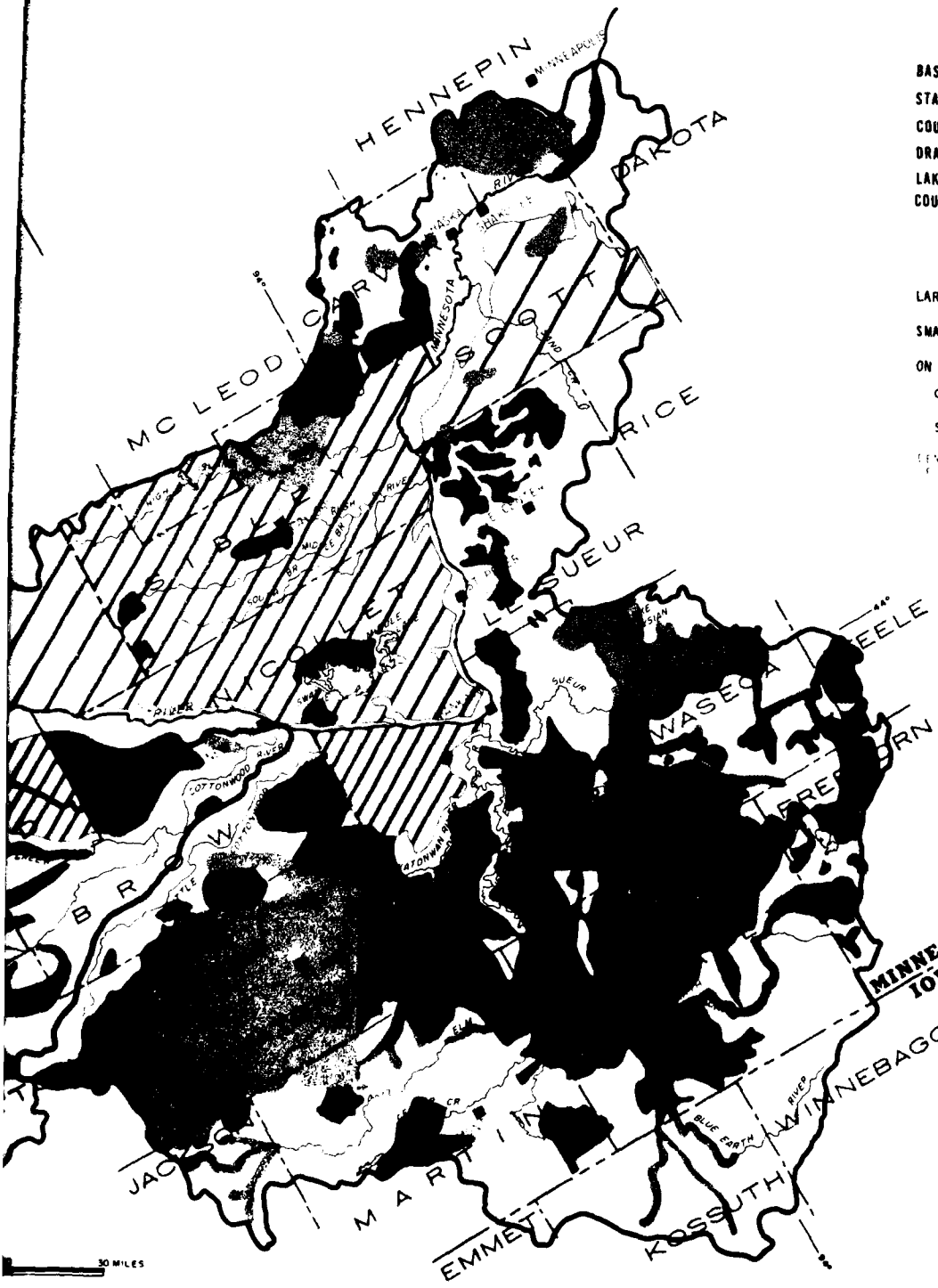
Some soils are subject to flooding and need flood protection to realize their full agricultural productive capacity. In some areas, channels are designed for both drainage and flood prevention. Outlets lacking sufficient capacity are a problem closely related to flood prevention. Adequate floodwater channels ordinarily fulfill the requirements for drain outlets.

On 1,844,300 acres of crop, pasture, and other agricultural lands in the study area, the major limitation or dominant problem is excess water. Wet soils constitute over 70 percent of all agricultural land. Not all of this area having wet soils needs drainage. Instead, present and future drainage needs depend on the desired use of the areas. The potential economic return for the landowner usually determines the use.

On-farm drainage needs total 1,035,000 acres as shown on the following figure. Included are cropland soils which need drainage and additional acres of less than well-drained soils. Some of these on-farm systems will depend on small group or multiland user coordination and/or major project action for outlets at additional costs for completion of effective systems. The acreage needing small group or multiland user coordination is estimated to be 400,000 acres. The total project acreage needing major project action for outlets or to alleviate the major drainage problems is estimated to be 680,000 acres. In addition to this land with dominant drainage treatment needs, considerable acreages of cropland in the basin with wet soils to a lesser extent or soils which are less than well drained may require drainage measures secondary to other forms of land treatment. The photograph on page 41 shows agricultural land which needs drainage.


U. S. DEPARTMENT OF AGRICULTURE
MINNESOTA
OTTER TAIL
GRANT
DOUGLAS
POPE
STEVENS
TRAVERSE
BIG STONE
MARSHALL
ROBE
CODINGTON
DEU
PARLE
BROOKIN
PIPEST
YELLOW BANK SUBBASIN
LAC QUI PARLE SUBBASIN
YELLOW MEDICINE SUBBASIN
REDWOOD SUBBASIN
COTTONWOOD SUBBASIN
SOURCE
FAMILY OF MAPS SCS DRAWING NO. 5-S-29-322-7-15-71- AND INFORMATION
FROM FIELD TECHNICIANS TRANSVERSE MERCATOR PROJECTION


HENNEPIN
MC LEOD
SCOTT
RICE
LE SUEUR
WASECA
YOHI
BROWN
COTTONWOOD RIVER




## LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE
- COUNTY SEAT

- LARGE GROUP
- SMALL GROUP
- ON FARM
  - CONCENTRATED AREAS
  - SCATTERED AREAS

DENSITY OF SYMBOL REFLECTS PERCENTAGE OF AREA WITH ON FARM DRAINAGE

UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY
by the
CORPS OF ENGINEERS AND
SOIL CONSERVATION SERVICE
MINNESOTA AND SOUTH DAKOTA

# DRAINAGE NEEDS

## MINNESOTA RIVER BASIN

*portion of the*

SOUTHERN MINNESOTA RIVERS BASIN STUDY

MINNESOTA, SOUTH DAKOTA, AND IOWA

REV. 6-1-78
S,S-35,275

Drainage is needed in some areas of wet agricultural land

## SOIL EROSION AND SEDIMENTATION

The most significant erosion problems in the basin are sheet and rill erosion caused by wind and/or water runoff. Sheet erosion is the removal of a relatively uniform layer of soil. Rill erosion is the formation of shallow channels that can be smoothed out by normal cultivation.

Sheet and rill erosion have caused the gradual removal of the more productive topsoils and, to a limited degree, have exposed the agriculturally less productive subsoils and parent materials (see the following photograph). The loss of topsoil has resulted in reduced natural productivity in some areas. Sheet erosion is a potential problem on all soils under adverse conditions, but especially on sloping soils and soils devoted to cultivated crops. The rate of sheet and rill erosion, as well as gully erosion, depends on many factors - rainfall, slope steepness and length, vegetative cover, soil type, and management.

Sheet and rill erosion cause the gradual removal of the productive topsoil

Erosion is generally more severe in early spring because vegetation on cultivated land is not fully established. Raindrops striking the soil have a large amount of energy, the moving force that begins erosion.

Erosion hazard is the major limitation or dominant problem on 1,075,000 acres of crop, pasture, forest, and other agricultural lands. Unless protected, these soils, constituting nearly 42 percent of all agricultural land in the study area, are subject to moderate to very severe erosion by water and/or wind. It is estimated 876,200 acres (82 percent) of land with this erosion hazard are cropland. There are 98,200 acres of pasture, 49,700 acres of forest land, and 50,900 acres of other agricultural land which also have an erosion hazard, but the problem is not as significant as that existing on cropland. These uses do not generally present an immediate sheet and rill erosion problem because the lands are not cultivated; however, significant amounts of pasture and woodland could experience severe erosion problems, especially if conversion of these marginal lands to croplands continues with the demand for increased production.

About one-third of the cropland with erosion hazards is adequately treated. Soil loss on acres needing conservation treatment exceeds the tolerable levels of 4 tons per acre per year. Almost two-thirds of cropland with erosion hazards is not being cared for in a way that protects the soil resource for sustained production. The following table shows acres of land adequately treated, those needing treatment, and the resultant soil loss per year.

Conservation treatment and soil loss on agricultural land, 1974

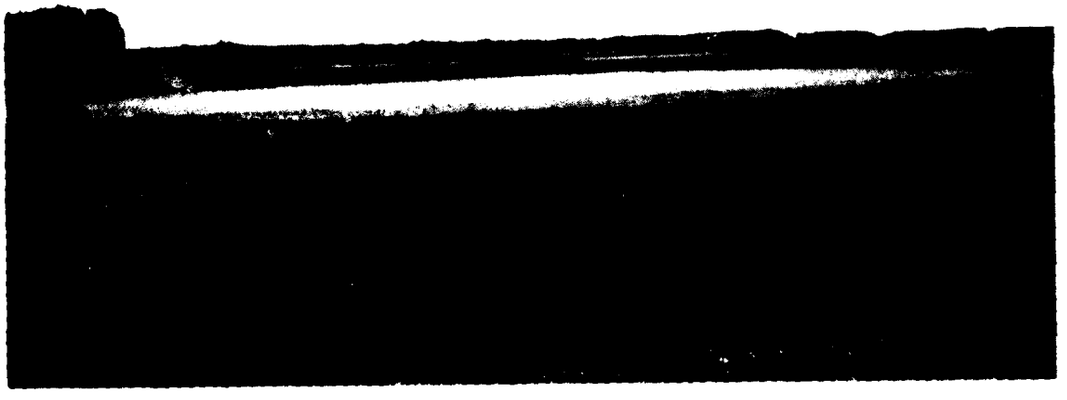
| Land use | Total acres (1,000) | Land adequately treated | | Land needing treatment | | Soil loss tons per year (1,000) |
|---|---|---|---|---|---|---|
| | | Acres (1,000) | Percent | Acres (1,000) | Percent | |
| Cropland | 2,142 | 750 | 35 | 1,392 | 65 | 7,972 |
| Pasture | 241 | 66 | 27 | 175 | 73 | 441 |
| Forest | 54 | 19 | 35 | 35 | 65 | 38 |
| Other | 134 | 95 | 71 | 39 | 29 | 167 |
| Total | 2,571 | 930 | 36 | 1,641 | 64 | 8,618 |

Wind erosion is a potential problem in localized areas, but overall is not a major problem. It occurs where topsoils are sandy or light textured, especially during drought years when plant cover is inadequate Airborne soil can act as an irritant to people. Removal of topsoil deposited in ditches and waterways can result in considerable maintenance costs.

Gully erosion, caused by flowing water, forms channels that cannot be smoothed out by normal cultivation. It is accelerated by the lack of vegetative cover and is generally most severe in cultivated areas on rolling topography. Upland gully erosion studies in forest areas show

that undisturbed forest land normally has few gullies and yields little overland flow, even under severe runoff conditions. However, localized erosion problems have resulted from grazing, poor management, or intensive land use above steeply sloping forest land.

Gullies adjacent to the rivers, degrading of ephemeral waterways, and drainage outlets in the subwatersheds are the major concerns (see the following photographs). Loss of land to advancing gullies and the resultant deposition of sediment are problems. Gully erosion destroys land by creating a void where the gully is formed. Gullies lower the utility of the land adjacent to them and damage roads, railroads, buildings, and fences. They are also a hazard to the farm operators and their livestock. In severely gullied areas, the annual gross soil loss can be as high as 400 tons per acre.



Windblown soil erosion in the Cottonwood River basin

Sediment deposits from flooding on Yellow Bank River at mouth of Mud Creek

The annual grass soil loss can be as high as 400 tons per acre in gullied areas

Streambank erosion is the removal of soil from the sides of rivers and streams and occurs principally during floods. The following photograph shows an example of stream erosion in the basin. Other problems include deposition of infertile sediment and dredging costs for maintenance of a navigable channel on the lower several miles of the Minnesota River.

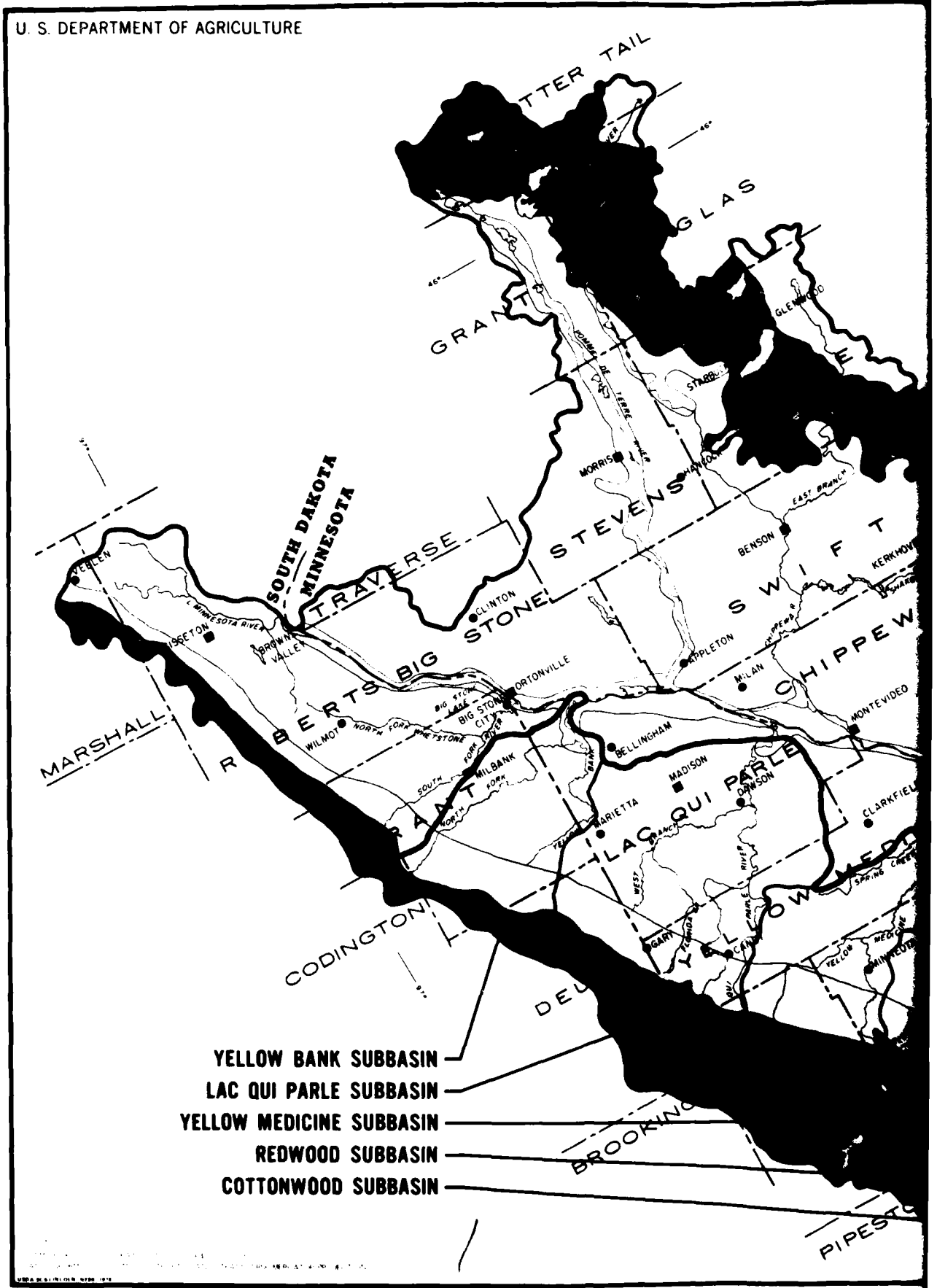
Streambank erosion

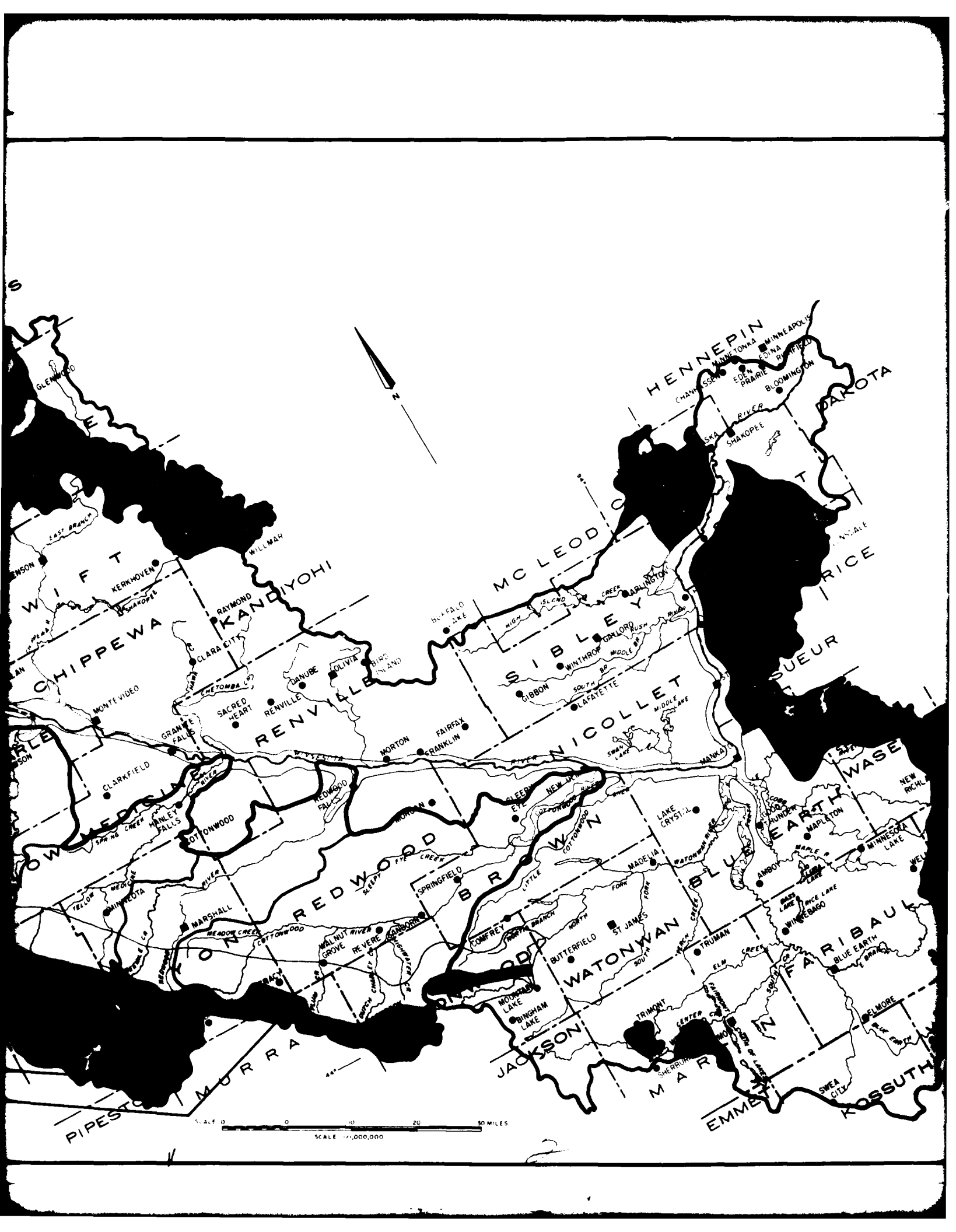
Shoreline erosion is not a major problem in the study area. Wave action causes fluctuation of the water level in certain lakes, resulting in some shoreline erosion. Monetary damages have not been studied.

Roadside erosion is a minor problem in contrast to the entire erosion problem. Erosion on road rights-of-way produces a sediment problem and is aesthetically unpleasing. In certain instances, it may create a safety hazard. An inventory of the roadside erosion problem has been completed by the Minnesota Department of Transportation and the Minnesota Chapter of the Soil Conservation Society of America. Problems include undermining of the roadway structure and use of roadside ditches as outlets for agricultural drainage. These problems result in a continued need for maintenance, replacement, and special roadside erosion control measures.

Erosion at construction sites on agricultural lands and urban and built-up noninventory land can be a serious problem if proper precautions are not taken. Erosion rates greater than 30 tons per acre can occur on land with moderate to serious erosion hazards. The small total area in the basin affected by erosion on construction sites at any one time, and the short duration of general construction activities during which soil is susceptible to erosion, make this problem only a small aspect in relation to the total erosion problem.

Sedimentation is a problem in the Minnesota River basin The sloping face of the Coteau des Prairies is a major sediment source area (see the following figure). Most of the lakes in the basin are undergoing sedimentation to some extent. Major drainage channels require periodic cleaning to remove accumulated sediment. The Minnesota River carries a moderate sediment load even under normal conditions because of the high percentage of cropland in its drainage area. It is a major source of sediment pollution to the Mississippi River above Lake Pepin. Above its junction with the Minnesota River, the Mississippi River is practically a clear water stream, even at flood stage. Partially because of the sediment carried by the Minnesota River, the Mississippi River is one of the few major rivers that has an increasing sediment load per unit of watershed area as the drainage area increases.


U. S. DEPARTMENT OF AGRICULTURE
SOUTH DAKOTA
MINNESOTA
YELLOW BANK SUBBASIN
LAC QUI PARLE SUBBASIN
YELLOW MEDICINE SUBBASIN
REDWOOD SUBBASIN
COTTONWOOD SUBBASIN


HENNEPIN
MINNEAPOLIS
MINNETONKA
EDINA
EDEN PRAIRIE
BLOOMINGTON
SHAKOPEE
DAKOTA
RICE
SUEUR
NICOLLET
SIBLEY
MC LEOD
WRIGHT
CARVER
SCOTT
WILLMAR
KERKHOVEN
KANDIYOHI
CHIPPEWA
RENVILLE
LAC QUI PARLE
YELLOW MEDICINE
LINCOLN
LYON
REDWOOD
BROWN
WATONWAN
BLUE EARTH
WASECA
FARIBAULT
MARTIN
JACKSON
COTTONWOOD
MURRAY
PIPESTONE
NOBLES
ROCK
EMMET
KOSSUTH
WINNEBAGO
FAIRMONT
ARLINGTON
GAYLORD
WINTHROP
GIBBON
LAFAYETTE
HENDERSON
CLARKFIELD
GRANITE FALLS
MONTEVIDEO
CLARA CITY
DANUBE
OLIVIA
SACRED HEART
RAYMOND
MORTON
FRANKLIN
SPRINGFIELD
SLEEPY EYE
NEW ULM
MANKATO
MADELIA
LAKE CRYSTAL
ST JAMES
BUTTERFIELD
TRUMAN
MAPLETON
AMBOY
MINNESOTA LAKE
BLUE EARTH
WELCOME
SHERBURN
TRIMONT
SWEA CITY
ELMORE
MARSHALL
REVERE
WALNUT GROVE
COMFREY
BINGHAM LAKE
MOUNTAIN LAKE
HANLEY FALLS
REDWOOD FALLS
BIRD ISLAND
BUFFALO LAKE
N
SCALE 0 10 20 30 MILES
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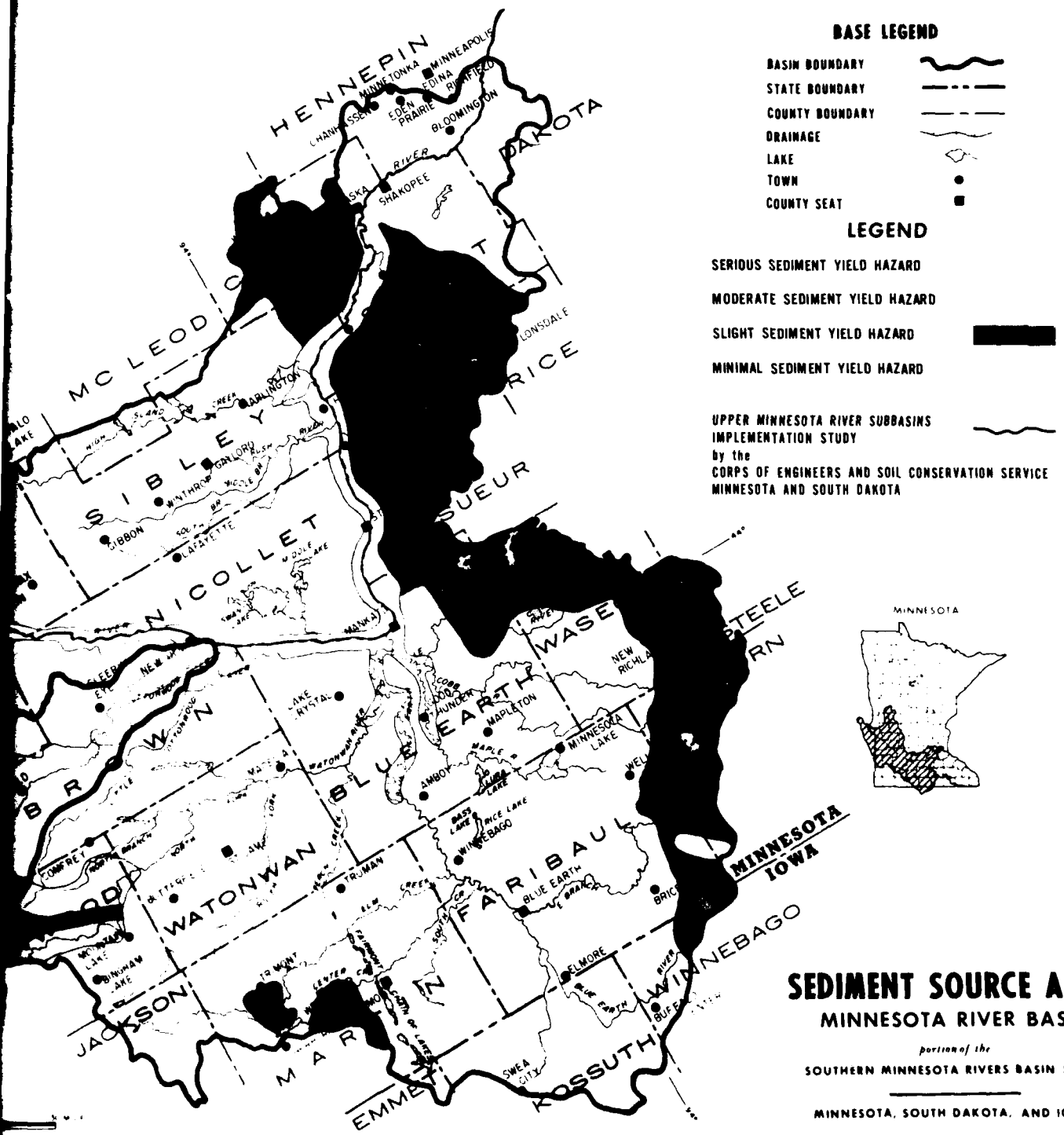



## BASE LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE
- TOWN
- COUNTY SEAT

## LEGEND

- SERIOUS SEDIMENT YIELD HAZARD
- MODERATE SEDIMENT YIELD HAZARD
- SLIGHT SEDIMENT YIELD HAZARD
- MINIMAL SEDIMENT YIELD HAZARD

*UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY*
by the
CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE
MINNESOTA AND SOUTH DAKOTA

# SEDIMENT SOURCE AREAS

## MINNESOTA RIVER BASIN

*portion of the*

SOUTHERN MINNESOTA RIVERS BASIN STUDY

MINNESOTA, SOUTH DAKOTA, AND IOWA

REV. 5-30-78
5,5-35,648

The major source of sediment in the study area is sheet erosion from cropland. Other types of upland erosion, such as gully and roadside erosion, are locally severe but do not constitute a significant source of sediment pollution. Streambank erosion is not a major source of sediment because erosion resistant material is present. Wind erosion on bare farmland is a major source of dust which has an adverse effect on air quality in the basin. Airborne sediment pollution is a problem principally in the fall and early spring.

The present emphasis in conservation farming is protecting tne soil resource base for continued productivity. A dramatic decrease in sediment pollution would require a combination of conservation farming measures designed principally for sediment abatement and mechanical control measures such as desilting dams to trap sediment.

Sediment fills lakes, reduces stream capacity, and is a major water pollutant

## PRESENT STATUS AND NEED FOR LAND STABILIZATION AND CONSERVATION

Protection and management measures, including all types of conservation treatment and practices, are a basic need in the conservation, development, and use of land and water resources. These measures are needed for crop, pasture, forest, and other agricultural lands throughout the basin.

Soils in the area are classified as follows:

1. Class I soils have few limitations on their use. They are deep, well-drained soils which are highly responsive to fertilizer and are suited to intensive cropping.

2. Class II soils have some limitations which reduce the choice of plants and require moderate conservation measures. The limitations, however, are few and the measures are easy to apply. Like Class I, these soils respond well to fertilizer and are very productive with proper management.

3. Class III soils have severe limitations which reduce the choice of plants and require special conservation practices. The limitations restrict the amount of cultivation, time of planting, kind of tillage, choice of crops and harvesting.

4. Class IV soils have very severe limitations which restrict the choice of plants and require very careful management. Although these soils are cultivated, careful management is required and conservation practices are difficult to apply and maintain. Class IV soils may be well suited to only two or three of the more common crops, and production is generally low.

5. Soils in Classes V through VIII are generally not suited for cultivation and are mostly used for pasture, woodland, and wildlife food and cover areas. Class V land is nearly level but wet and subject to flooding and ponding hazards, which are impractical to remove. Class VI soils are such that it is practical to apply pasture improvements including seeding and fertilization. Such practices are generally considered impractical on Class VII soils. Soils in Class VIII have possible uses for wildlife, watershed protection, or recreation, but are unsuited for commercial production.

The four kinds of limitations recognized in Minnesota at the subclass level are:

- E - Susceptibility to erosion is the dominant problem or hazard. Susceptibility and past erosion damage are the major factors factors for placing soils in this category.

- W - Excess water is the dominant hazard or limitation. Poor soil drainage, wetness, high water table, and overflow are the criteria for determining which soils belong in this subclass.

- S - Root zone limitations are the dominant hazard or limitation. Soils in this subclass have such limitations as shallow depth, low available water capacity, or slow permeability.

- C - Climate (temperature) is the only major hazard limiting use. Much of Minnesota has a growing season of less than 120 days.

The class and subclass provide information about the degree and kind of limitation. Subclasses are not recognized in class I.

Limitations imposed by erosion, excess water, shallow soils, stones, or low available water capacity can be modified or partially overcome and will take precedence over climate in determining subclasses. The dominant kind of limitation or hazard determines the classification. Where two kinds of limitations that can be modified or corrected are essentially equal, the subclasses have the following priority: E, W, S, C.

The following table categorizes soils in the study area by class and subclass.

Acreage in the study area inventoried by land capability class and subclass (1967 Conservation Needs Inventory)

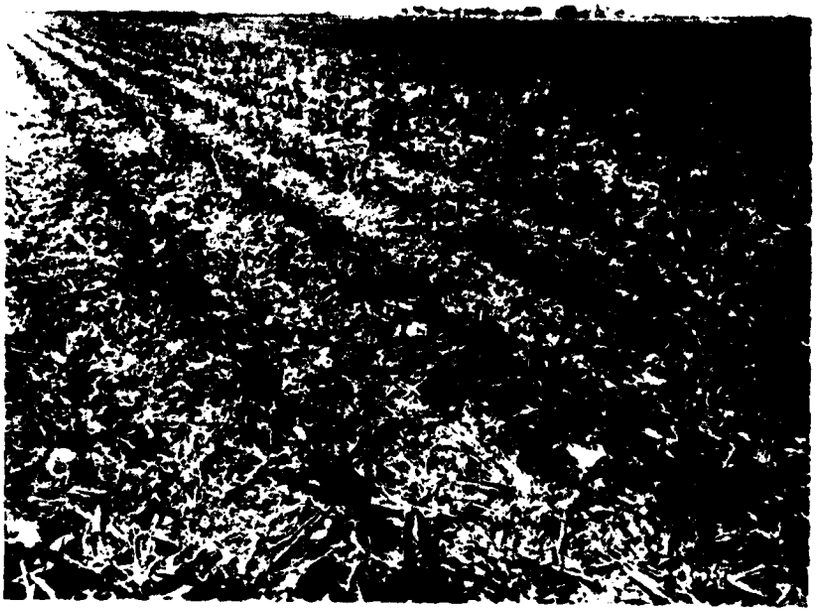
| Class | Subclass | Acres |
|---|---|---|
| I | | 264,846 |
| II | E | 836,997 |
| | W | 731,051 |
| | S | 59,290 |
| | C | 0 |
| | Total | 1,627,338 |
| III | E | 190,321 |
| | W | 199,807 |
| | S | 54,622 |
| | C | 0 |
| | Total | 444,750 |
| IV | E | 60,102 |
| | W | 1,328 |
| | S | 3,485 |
| | Total | 64,915 |
| V | E | 0 |
| | W | 13,319 |
| | Total | 13,319 |
| VI | E | 23,743 |
| | W | 54,470 |
| | S | 1,203 |
| | Total | 79,416 |
| VII | E | 31,780 |
| | W | 0 |
| | S | 20,735 |
| | Total | 52,515 |
| VIII | W | 20,239 |
| | S | 3,194 |
| | Total | 23,433 |
| Total acres inventoried | | 2,570,532 |

About 93 percent of the study area's land resources is in Classes I through IV and is generally suited for cultivation with practical land treatment. The 6 percent of the remaining land in Classes V through VII is suitable for grazing or forest with proper management. Less than 1 percent of the area's inventoried land has limitations precluding its use for commercial production.

Land in the area is highly productive for agricultural crops. The two most productive SRG's (Soil Resource Groups) contain 74 percent of the agricultural land. The most prevalent SRG contains 2.0 million acres of deep, medium to moderately fine textured upland soils. Soils in this SRG are either capability Class I or II and require only limited land treatment. These soils are well suited for corn and soybean production and can be expected to sustain high yields with proper management.

Twenty-three other SRG's are used to analyze production capabilities of the remaining 26 percent of the land. A much wider range of crops. crop yields, land treatment, and management practices is associated with these soils. Approximately 21 million acres is in Classes II, III, and IV, and is suitable for cultivation when adequately treated. Some of these soils have unique characteristics making them suited for production of various specialty crops, as well as the more common field crops. The remaining 168,683 acres is in Classes V through VIII, which have hazards limiting use to pasture, forest, recreation, or wildlife cover and protection.

Fertility management is generally needed even on Class I soils. Crop residue management and minimum tillage are desirable practices for maintaining and building soil structure on all classes of land (see the following photograph).



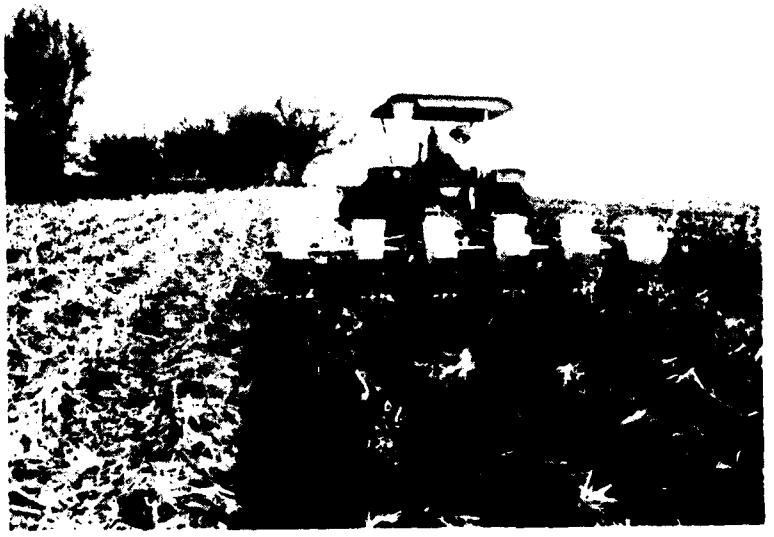
Crop residue will protect and improve the soil

The 1967 Soil and Water Conservation Needs Inventory was used as base data for the study area. An update to 1974 was done using existing trends and conservation accomplishments through the judgment and knowledge of persons within individual counties. It is not based on statistical sampling as was done in 1967.

Of the 2,570,532 acres of agricultural land in the study area, 951,907 acres, or 38 percent, is adequately treated.

Eighty-three percent of the agricultural land in the study area, or 2,142,720 acres, is devoted to crop production - 35 percent of all cropland is adequately treated; 23 percent has a major need for residue and annual cover; 18 percent needs sod in rotation or a comparable level of management; 12 percent needs contouring; 15 percent needs strip-cropping, terraces, or diversions; nearly 2 percent needs conversion to permanent cover; and 31 percent has major needs of improved drainage.

When erosion hazard is slight, it was assumed that residue, annual cover, or minimum tillage (see the following photograph) was the most likely alternative for treatment. When the degree of erosion hazard increased to moderate, sod in rotation or contouring was selected. Sod in rotation has been used as a soil productivity maintenance practice and also has merits in reducing susceptibility of soils to erosion as part of the overall rotation. With increasing demand for grain crops and continued availability of commercial fertilizers, the use of sod in rotation as a practice will likely decrease.



Minimum tillage protects the soil from erosion and conserves moisture

The major treatment need for cropland soils with a wetness problem was generally assumed to be surface and subsurface drainage systems.

About 10 percent, or 248,460 acres, of the agricultural land in the basin is devoted to pasture - 27 percent of the pastureland is adequately treated, 60 percent needs protection from overgrazing

only, 21 percent needs improvement only, 12 percent needs reestablishment of vegetative cover, 6 percent needs brush control and improvement, 7 percent is not economically feasible to treat, and only 75 acres needs a change of land use to woodland.

Only 53,550 acres or slightly more than 2 percent of the basin is devoted to forest and woodlands - 36 percent of the forest land is adequately treated, 23 percent needs establishment and reinforcement, 39 percent needs timber stand improvement, and 2 percent is noncommercial forest needing varied treatment. All commercial forest in the basin is grazed and needs treatment for grazing; 30 percent needs forage improvement.

Five percent of the agricultural land in the basin is devoted to other land uses. Other land is non-Federal rural land not classified as cropland, pasture or forest and includes farmsteads, farm roads, feedlots, ditch banks, fence rows, small stock ponds, small shelterbelts, certain wetlands, wildlife lands, rural nonfarm residences, borrow acres, churches, and cemeteries. Seventy-one percent of the other land in the basin is adequately treated. The remaining 29 percent needs varied forms of treatment including erosion control, farmstead windbreaks or shelterbelts, and agricultural waste management systems.

## POLLUTION

In response to the Nation's needs and desire to improve the environment, Congress enacted the Federal Water Pollution Control Act Amendments of 1972. These amendments established a national goal of achieving water quality adequate to allow fishing and swimming in all of the Nation's surface waters by 1983. The Minnesota Pollution Control Agency has responsibility for determining the best current uses to which the State's waters may be put and the quality of the waters necessary to meet these uses.

Soils throughout the study area are considered highly fertile consisting of sandy to clay-type loams and tills. Many of these soils are highly susceptible to water and wind erosion. Both erosional types contribute significantly to nonpoint source pollution problems.

Many of the lakes in the study area are shallow, warm, and turbid and extremely susceptible to eutrophication. These lakes have high phosphorus, nitrogen, and alkalinity levels. The most probable source of these nutrients is overland runoff across erodible soils in agricultural fields.

In 1969, farmers in the Minnesota River basin purchased $2,417 of commercial fertilizer (a possible source of nutrient pollutants) per square mile compared to a State average of $1,027 per square mile. In that same year, Minnesota River basin farmers spent $856 per square mile for nonfertilizer chemicals.

Improvements needed in fishing lakes are shown in the following table.

Improvements needed in fishing lakes, 1972[1]

| County | Lake[2] | Improvement needed: Surface area | Depth | Silt | Weeds | Algae | Fluctuations | Fish | Water quality | Public access |
|---|---|---|---|---|---|---|---|---|---|---|
| Minnesota | | | | | | | | | | |
| Brown | Boys (Boise) (8-96) | | X | X | X | X | | | | |
| | Sleepy Eye (8-45) | | X | X | X | X | | X | | |
| Cottonwood | Bean (17-54) | | X | X | | | X | X | | X |
| | Double (17-56) | | X | X | | X | X | X | X | |
| | Long (17-48) | | X | X | | | X | X | | |
| Lac qui Parle | Lac qui Parle (37-46) | | | X | | X | | | X | |
| | Pegg (37-224) | | | | | | | | | X |
| | Salt (Rosabel) (37-229) | | | | | | X | | X | |
| Lincoln | Benton (41-43) | | X | X | | X | | X | | |
| | Hendricks (41-110) | | X | X | | X | X | X | | X |
| | Shoakatan (41-89) | | X | X | | X | | X | | |
| Lyon | Cottonwood (42-14) | X | | | | | | | | |
| | Goose (42-93) (SWC) | | | | | | | X | | |
| | School Grove (SWC) (42-2) | | X | | | | | | X | |
| | West Twin (42-74) | | | | | X | | X | | |
| Yellow Medicine | Miedd (87-61) | X | X | | | | | | | X |
| | Spellman (87-60) | X | X | | | | X | X | | |
| South Dakota | | | | | | | | | | |
| Brookings | Hendricks (41-110) | | X | X | | X | X | X | | X |
| | Oak (C) | | X | X | | X | | | X | |
| Deuel | Cochrane (A) | | X | X | | | | | X | |
| | Fish (B) | | X | X | | X | | | X | |

(1) As designated by local people and Minnesota Department of Natural Resources.

(2) Identification numbers, Minnesota Department of Natural Resources.

A number of the lakes have seasonal residences along their shores. The septic tank effluent from these residences is partially responsible for the pollution of the lakes.

The Minnesota Pollution Control Agency determined that, of the 133 communities in the Minnesota River basin, 29 provide adequate sewage treatment, 25 are expected to be able to provide adequate treatment by making various operational or maintenance improvements to existing facilities, 60 must upgrade or replace their facilities, and 19 have no facilities other than private septic tanks. Of the 46 industrial dischargers in the basin, 13 provide adequate treatment and 33 are inadequate.(1)

A more perplexing problem is that of nonpoint sources of pollution. The extent of actual nonpoint source pollution depends on natural conditions and control measures, or lack of such, assicated with such land uses as tillage, chemical applications, livestock containment, and construction. Lack of proper land treatment practices has resulted in increased pollution in the basin.

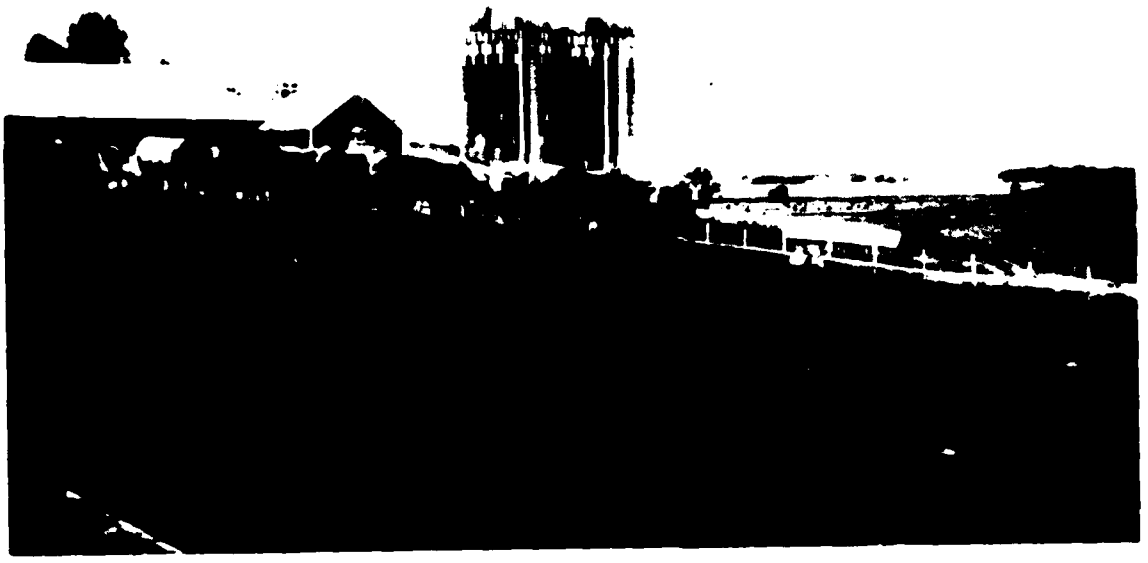
Although total livestock numbers have not changed significantly, new technology and management practices have significantly changed their concentration. The general trend of larger and more concentrated feeding areas has resulted. With this trend has grown the concern over environmental effects on surrounding areas and water resources.

In an attempt to indicate the level of concentration in the basin, the number of feedlots and number of cattle by feedlot size were estimated. Using 1969 Agricultural Census and Statistical Reporting Service data, 174,347 head were being fed on the area's 3,405 feedlots. Approximately 20 percent of fed beef was in 5 feedlots with over 1,000 head. Another 42 percent was fed in feedlots of 500 to 1,000 head each. The remaining 38 percent of the basin's fed beef was grown in smaller feedlots not exceeding 500 head.

(1) Water Quality Management Basin Plan, Minnesota River Basin, Minnesota Pollution Control Agency, June 1975.

A number of feedlots are in areas with direct accessibility to surface waters. In many areas, pastures used for livestock production are undesirable because livestock have direct access to streams and lakes. The Minnesota Pollution Control Agency found that pollution potential from livestock production in the study area is high.

It is estimated that 2,000 livestock enterprises are potential nonpoint sources of pollution. In the future, as municipal and industrial point source effluents are improved and point source impacts are determined through increased monitoring, the effects of nonpoint sources on streams will become even more evident.



Farm barnyard potential for nonpoint pollution in the area (1972)

## FISH AND WILDLIFE

The major problems for wildlife within the basin are continued loss of habitat to other land uses and deteriorating quality of remaining habitat acres. These problems result from increased demands on land and water resources, primarily for agricultural production and urban expansion.

The major losses of woodland are to recreation, country home sites, and expanded crop production. The loss of woodlots, windbreaks, and brush cover between and within fields is the most detrimental to woodland wildlife species. These losses eliminate vast acres of food producing cropland from use by these species which must have protective cover near their food sources. As a result, animals are mostly limited to lands bordering the wooded river bottoms where cover is available.

The quality of woodland habitat suffers from overgrazing, inadequate ground cover, improper distribution, and stand maturity. Most of the present windbreaks are single row and lack coniferous species. Although these windbreaks provide travel lanes, they do not provide adequate protection from winter storms or predators.

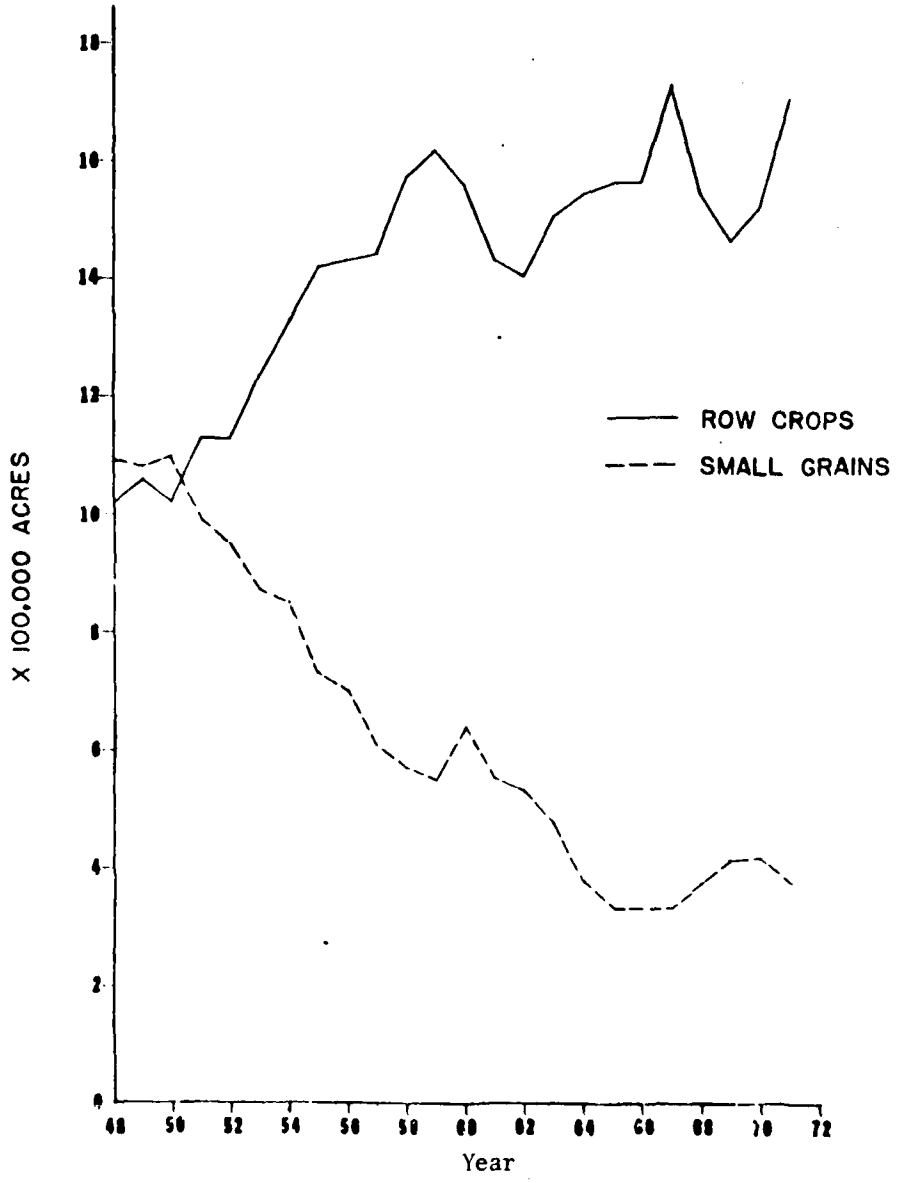
The population levels of woodland wildlife which are desirable and compatible with agricultural production within the basin must be determined. Incentives are needed to encourage private landowners to retain and improve their woodlots and windbreaks and manage woodlands for wildlife. Multirow windbreaks and small block plantings of trees and shrubs are needed in the heavily cropped portions of the basin to replace past and current losses and provide a better distribution of woodland acres.

Research in the study area by the Minnesota Department of Natural Resources and other supporting data were reviewed and summarized to determine contributing factors for the downward trend of pheasant populations. Problems and needs of pheasant habitat are similar to those of most upland species. Therefore, they are presented as being representative for the upland wildlife group.

Land use trends, predation, and climatic conditions were cited as the major factors involved in the declining pheasant population. Shifting land use was the major impact, in that less cover was available for protection from predation and severe weather. Considerable natural cover, including residual herbaceous cover once found along fencelines, borders, ditches, and odd corners, has been lost to agricultural uses. The departure from crop rotation systems to continuous row cropping has drastically reduced the quantity of small grain acres available for nesting habitat (see the following figure). Pasture and hayland acres have steadily declined as well. While lightly grazed pasture provides good nesting cover, most remaining pastureland in the basin is moderately to heavily grazed. Legume hay also attracts nesting birds. However, since hay is mowed early in June, nest failure is high and many hens and chicks are killed or injured during mowing. These combined losses of "safe" nesting habitat are cited as primary factors in the decline of pheasant numbers. (See the figure on page 64.)

# TRENDS IN AGRICULTURAL LAND USE IN RELATION TO PHEASANT NESTING HABITAT 1948–1971

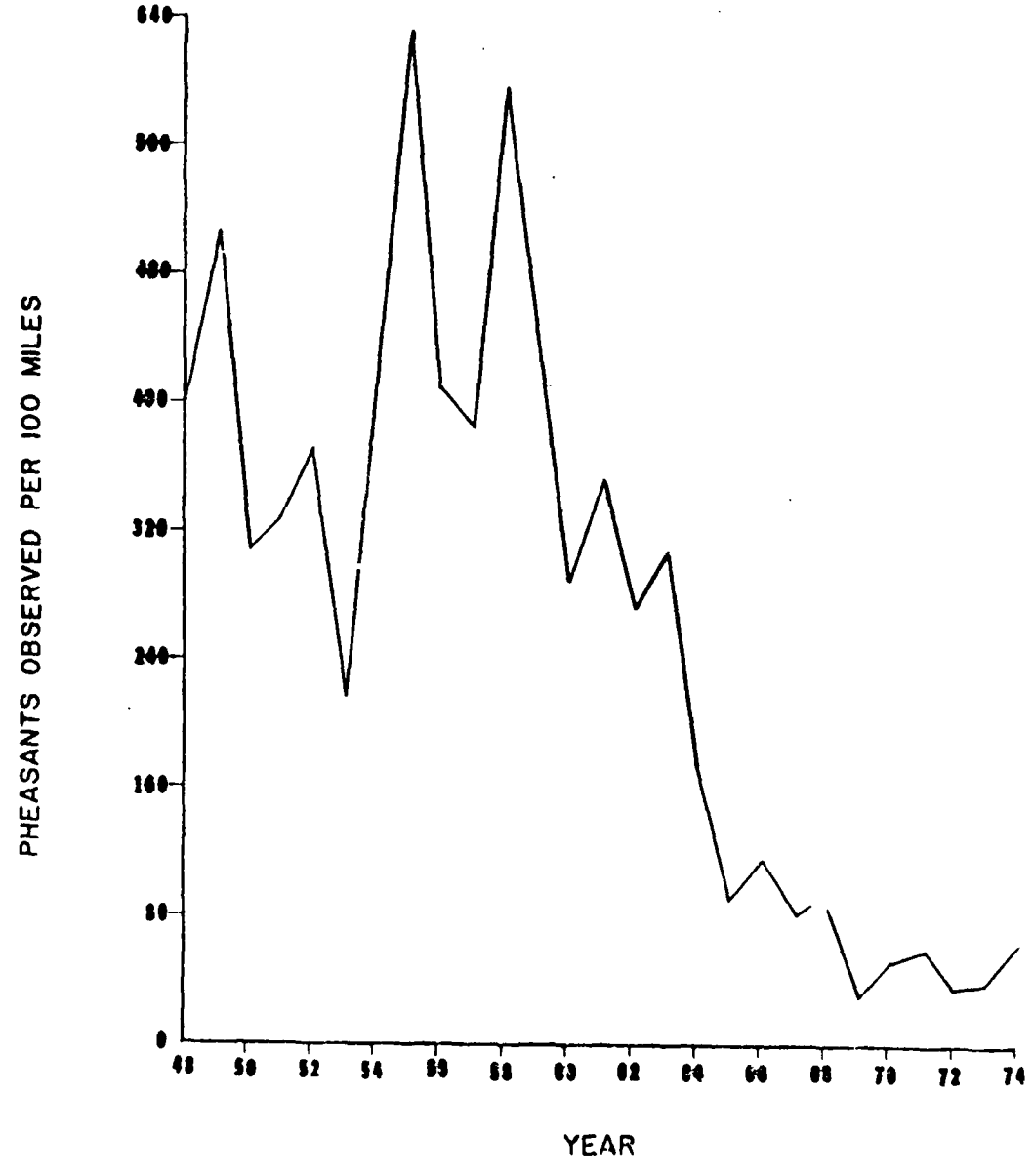
STUDY AREA



# AVERAGE AUGUST ROADSIDE PHEASANT COUNT

STUDY AREA

1948-1974



Although corn and soybeans are major food items in the pheasant's diet and abundant supplies are an asset, the availability of waste grain in winter is largely determined by the amount of fall plowing and the snow depth which remains over winter. Virtually all the row crop acres are fall plowed, eliminating those acres from use for winter food or cover. The continued loss of woodlots, windbreaks, and brush cover has also seriously reduced the availability of winter and escape cover for pheasants and other upland species.

The major needs for upland wildlife habitat per section are: 50 to 75 acres of properly managed grass or legume cover, at least one stand of dense coniferous and low deciduous tree cover of 1 to 15 acres, and standing food plots of 1 to 3 acres near established winter cover. Greater use of soil suitability information should be made in land use decisions. Many areas of rough, rolling land with complex slopes are better suited for grassland, hay, or pasture than for grain crop production.

Wetland habitat in the study area continues to decline. The major problem lies in the inherent conflict with agricultural drainage needs. Wetlands which keep groundwater levels high or restrict surface drainage tend to reduce production on surrounding croplands. Although this conflict has existed since early settlement of the basin, recent increases in production costs and national emphasis on all-out crop production have greatly intensified the problem. Many type I, II, and III wetlands are cropped whenever dry conditions exist (see the following tables). Where types III, IV, and V wetlands remain intact, surrounding nesting habitat is generally lacking due to overgrazing, burning, or encroachment by croplands. Eutrophication and sedimentation have accelerated the evolution of many wetlands to more shallow, drier types.

Summary of wetlands 10 acres or larger in the study area

| Wetland types | Total acres |
|---|---|
| Dry or drained basins | 29,593 |
| Partially drained basins, some wetland remains | 1,964 |
| Type II | 157 |
| Type III | 4,201 |
| Type IV | 16,891 |
| Type V | 9,374 |
| Type VI | 28 |
| Unclassified | 249 |
| Total | 32,864 |

Wetlands in the study area owned or managed by State or Federal agencies

| Management agency | Total acres |
|---|---|
| Minnesota | |
| Federal (U.S. Fish and Wildlife Service)(1) | 1,042 |
| State(2) | 10,926 |
| South Dakota(3) | |
| Federal (U.S. Fish and Wildlife Service) | 1,144 |
| State | 1,047 |
| Total (State and Federal) | 14,159 |
| All managed acres (wetlands and upland) Federal and State | 45,799 |

(1) All wetland acres, regardless of size. From information provided by U.S. Fish and Wildlife Service, wetland acres average 39.86 percent of all acquired acres, and 24.17 percent of all easement acres on waterfowl production areas in Minnesota.

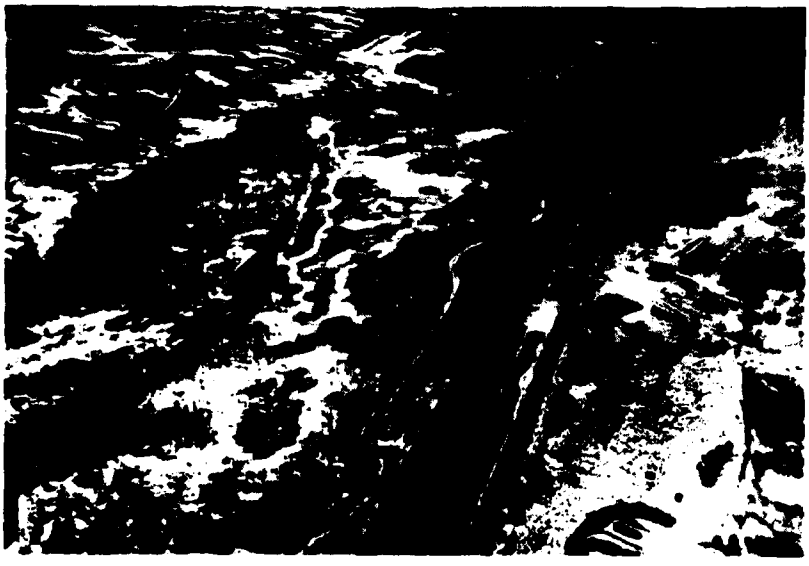
(2) All wetland acres, regardless of size. Wetland acres were calculated at 30 percent of all managed acres within the basin by the Minnesota Department of Natural Resources.

(3) All wetland acres, regardless of size. Wetland acres were calculated at 33 percent of all managed acres, based on information supplied by South Dakota.

The need for wetland preservation is indicated by the priority placed on the region by State and Federal acquisition programs. Acceleration of these programs is needed. The greater need, however, is to provide incentives to private landowners to retain and manage their wetland acres as wildlife habitat. Approximately 60 percent of the remaining wetland resources in the study area is privately owned. Without the support and cooperation of private landowners, attempts to preserve those wetlands will fail. Wetland areas are shown in the following photographs.

A productive wetland area

Potholes and wooded creeks in Deuel County, South Dakota, 1972



Man-made lake and wetlands in the lower Lac qui Parle River

The study area is oriented toward agricultural production and will remain so in the future. The acres of land available to provide adequate habitat for wildlife are limited; thus, multiple use of those acres by a variety of species is imperative. The needs of the various species of wildlife are interrelated and interdependent. The main objective of wildlife habitat improvement should be establishment of vegetative diversity. Such diversity should provide stratification from ground cover (grass) to overstory (trees) and be distributed in a manner which maximizes "fringe" with other vegetative types. These patterns of interspersed vegetation can only be achieved with full cooperation between wildlife agencies and private landowners who control the majority of land and, therefore, the ultimate fate of the basin's wildlife resources.

The study area's fishing waters share common problems - sedimentation, rough fish invasion, and eutrophication. Removal of shoreline and streambank vegetation by grazing, development, and other causes has not only created erosion problems, but has reduced spawning habitat and protective shaded areas. Erosion from croplands carries pesticides and nutrients, as well as silt, into most of the lakes which compound the winterkill and eutrophication problems inherent to the region. Siltation is a major problem in the rivers and streams. Carp and other rough fish problems are nearly universal. While total production of fish generally increases in carp infested waters, it is usually at the expense of game fish. The table on page 58 indicates improvements needed on the fishing lakes in the study area.

Land treatment practices are needed to reduce erosion rates to acceptable levels.

## RECREATION

The demand for outdoor recreation opportunities has steadily increased in the past two decades. Measuring that demand accurately and predicting future needs is a difficult task. Changes in economic conditions, population, leisure time, and especially user attitudes can produce wide variations in activity levels.

Current methodology is a problem in itself. Basic data concerning actual use of facilities by the public are often not available, primarily because of insufficient funding for user surveys. Space standards for the different activites are not universally accepted. and usually vary by planning agency from region to region. No satisfactory method is available to evaluate quality of recreation experience in quantitative terms for planning use. A better understanding of man's need for recreation and his expectations from it is needed.

Projected future levels of participation in recreation activities in the study area and the resulting resource requirements are listed in the following tables. Water-based activities are not equally available within the study area. Large deficiencies in lake acres are projected in the area (see the following table). Problems with depth, sediment, eutrophication, and water quality restrict the use of many lakes for recreation purposes. Conflicts between incompatible activities such as water-skiing and boat fishing are also common. There is a need for cooperative area-wide lake surveys to identify those which can feasibly be improved by dredging, increased outlet elevations, upstream sediment traps, and other improvement practices. Suitability groupings for lake associated activities could then be determined, and recommendations for proper use or uses of the lakes could be made.

Most water enhanced and land based facilities are deficient area-wide, and some represent important priorities for additional development. Developed miles of nature trails are less than 10 percent of future needs. Snowmobile trails and developed acres for picnicking and camping represent less than 10 percent of those needed by year 2000 (see the tables on pages 71 and 72.)

Projected outdoor recreation activity occasions expected to occur on an average weekend day - year 2000, study area

| Activity | Occasions |
|---|---|
| Swimming | 44,669 |
| Golf | 5,053 |
| Tennis | 5,158 |
| Outdoor games | 78,815 |
| Walking for pleasure | 11,228 |
| Bicycling | 54,365 |
| Horseback riding | 2,879 |
| Trap and target shooting | 840 |
| Fishing | 11,836 |
| Boating | 3,755 |
| Canoeing | 3,424 |
| Water-skiing | 17,751 |
| Sailing | 607 |
| Camping | 18,761 |
| Hiking | 894 |
| Picnicking | 18,456 |
| Nature walks | 19,820 |
| Snowmobiling | 15,336 |
| Snow skiing | 713 |
| Small game hunting | 5,198 |
| Large game hunting | 14,953 |
| Waterfowl hunting | 3,343 |

Resources necessary to provide future (year 2000) recreation levels with acceptable space standards, study area(1)

| Facility | Number |
|---|---|
| Swimming beach | |
| Water (acres) | 15.1 |
| Land (acres) | 75.5 |
| Pools (1,000 square feet) | 502.5 |
| Golfing (rounded to even 9-hole course) | |
| Holes | 162 |
| Acres | 1,620 |
| Tennis (courts) | 161 |
| Outdoor game fields (acres) | 904.7 |
| Trap and target shooting (acres) | 420 |
| Fishing - water (acres) | 26,631 |
| Boating - water (acres) | 5,007 |
| Canoeing - stream (miles) | 214 |
| Water-skiing - water (acres) | 44,378 |
| Sailing - water (acres) | 809 |
| Camping - sites | 8,934 |
| Camping acres | |
| Developed | 938.1 |
| Support | 4,690 |
| Hiking trails | 17.9 |
| Picnicking tables | 3,076 |
| Picnicking acres | |
| Developed | 615.2 |
| Support | 3,076 |
| Nature trails (miles) | 396.4 |
| Snowmobile trails (miles) | 511.2 |
| Hunting small game (upland acres) | 41,584 |
| Hunting large game (upland acres) | 956,992 |
| Hunting waterfowl (wetland acres) | 15,044 |

(1) Standards not available for bicycling, horseback riding, or walking for pleasure. Acres for large game hunting are based on a 2-day season, which has been established in the Minnesota River basin area in recent years.

Outdoor recreation facility needs, 1975 and 2000

| Facility | Amount(1) 1975 | 2000 |
|---|---|---|
| Swimming beach | | |
| Water (acres) | -1.0 | -2.7 |
| Land (acres) | -63.0 | -71.6 |
| Pools (1,000 square feet) | -381.6 | -438.6 |
| Golfing (rounded to even 9-hole course) | | |
| Holes | - | -18 |
| Acres | -430.0 | -610.0 |
| Tennis courts | -42 | -112 |
| Outdoor game fields (acres) | -487.5 | -609.7 |
| Fishing water (acres) | -979 | -5,693 |
| Total recreation water (acres) | -13,837 | -40,682 |
| Camping - sites | -1,484 | -4,202 |
| Camping - developed (acres) | -331.3 | -875.0 |
| Picnicking - tables | -1,417 | -2,221 |
| Picnicking - developed (acres) | -411.9 | -572.7 |
| Hiking trails (miles) | +24.1 | +23.1 |
| Nature trails (miles) | -318.5 | -383.4 |
| Snowmobile trails (miles) | -447.5 | -475.2 |
| Hunting small game (upland acres) | -10,216 | -9,944 |
| Hunting waterfowl (wetland acres) | -1,569 | -885 |

(1) - indicates deficiency.
+ indicates surplus.

Development priorities(1) - outdoor recreation

| Facility | Priority 1975 | 2000 |
|---|---|---|
| Swimming beach | | |
| Water | 10 | 9 |
| Land | 1 | 1 |
| Pool | 2 | 2 |
| Golfing | | |
| Holes | 10 | 9 |
| Acres | 8 | 7 |
| Tennis courts | 6 | 3 |
| Outdoor game fields | 4 | 4 |
| Fishing water | 10 | 8 |
| Recreation water | 8 | 5 |
| Camping | | |
| Sites | 2 | 1 |
| Acres | 1 | 1 |
| Picnicking | | |
| Tables | 4 | 3 |
| Acres | 1 | 1 |
| Hiking trails | 10 | 10 |
| Nature trails | 1 | 1 |
| Snowmobile trails | 1 | 1 |
| Hunting small game | 8 | 8 |
| Hunting waterfowl | 9 | 10 |

(1) Based on percent of need being supplied by present facilities. Example; if present facilities are 0-10 percent of those needed, priority is No. 1; 10-20 percent, priority is No. 2; 90-100 percent, priority is No. 10, etc.

Public access to the various facilities is a key factor to the use of recreation resources. The major needs for increased public access are to lakes and streams and to private lands for hunting. Many of the more popular lakes will continue to be overcrowded until demands are redistributed to areas underused or presently inaccessible. Problems of hunter and recreationist abuse of privileges have closed much of the private land to public access. The study area has insufficient acres of public hunting lands to meet its needs for small game and waterfowl hunting, The entire area must depend upon private lands for big game hunting. Stream fishing and canoeing also require some access to private lands. Thus, cooperative programs which emphasize user responsibilities and provide incentives to landowners to allow public use of their land for hunting and other activities are needed.

Public access is a key factor to the use of recreational resources

Hunting activity fluctuates with supplies of game, hunter density, established seasons, bag limits, and weather conditions. The problems and needs for supplying adequate numbers of game species are discussed in the wildlife section of this chapter. Hunting, as a socially acceptable form of outdoor recreation, has become a controversial issue in recent years. All segments of society need to fully understand the implications of this issue on wildlife populations and management and on hunters and nonhunters alike. Greater emphasis on nonconsumptive uses of wildlife, such as birdwatching, photography, and nature study, is needed in wildlife management programs. An intensive information program stressing the interrelationships between man and the ecosystem, the actual effects of regulated hunting upon wildlife populations, and sportsman ethics should become an important part of all natural resource budgets.

The development of recreation facilities and associated resources in the basin will require a coordinated program, enlisting the full cooperation of all governmental levels and the private sector. Study area priorities may change when placed in a context of State and regional needs. The 1974 Minnesota SCORP presents a framework for such a coordinated program and provides the necessary guidance for future action. As a step in achieving a properly developed recreation system, SCORP is a major accomplishment. It deserves the full support of all resource and recreatior interests, both in cooperative planning and providing adequate future funding.

## CULTURAL RESOURCES

Residents of the upper Minnesota River basin are concerned about the aesthetics of the area and have made efforts to preserve and develop natural and cultural areas and features of aesthetic and scientific value. Efforts to preserve natural wildlife and vegetation will contribute to an understanding of the basin's changing environment during prehistoric and historic times. A number of structures and sites have been formally

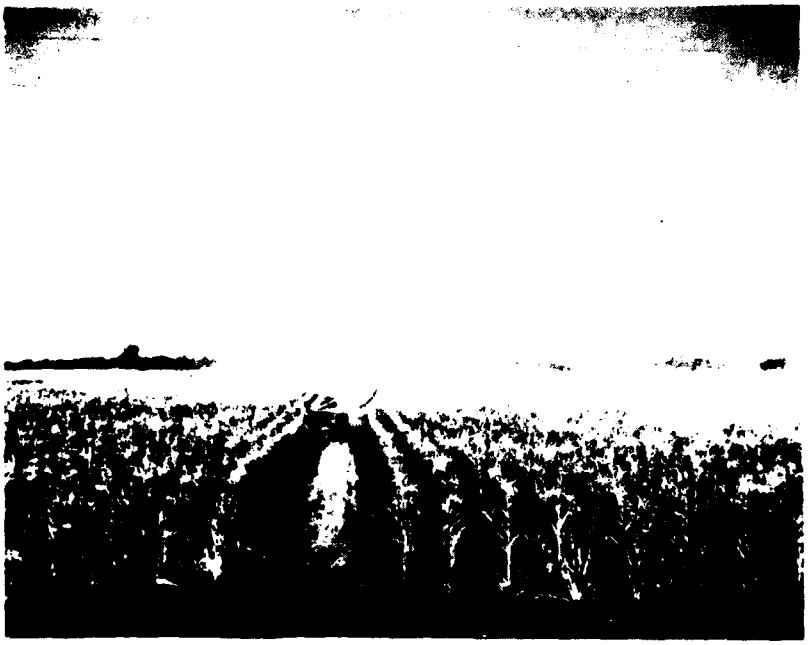
recognized for their cultural significance and included on the National Register of Historic Places. Other sites, some yet to be discovered, are potential candidates for the register. All project impact areas will be investigated to identify and evaluate potentially significant cultural remains. Before any project features are constructed, all significant cultural resources that cannot be avoided, protected, or relocated will be recovered through a scientific data recovery program. Cultural resources that are preserved or recovered will be an important data base for public interpretation and future scientific research.

The geologic resources of the basin must also be developed further. The channel of the ancient River Warren has been recognized as a Nationally Registered Natural Landmark. Also of scientific and interpretive interest in the Minnesota River valley near Morton and through the Granite Falls area are exposed areas of some of the world's oldest bedrock, dating back 3.8 billion years.

## WATER SUPPLY

In general, no municipal water shortages exist. Few are anticipated with projec ' growth.

In 1970, gross water requirements for irrigation were 310 acre-feet. To satisfy economic potential for irrigation in 2020, it is projected that 140,000 acre-feet of water will be required. In addition, water withdrawals for livestock and rural domestic uses are projected to increase from 10 mgd in 1960 to 30 mgd in 2020. A portion of this requirement for livestock water is provided by dugouts and ponds.



Sprinkler irrigation provides water for crops during dry years

The U.S. Geological Survey is conducting groundwater studies to determine irrigation potential in the Minnesota River basin. The Bonanza Valley Area Ground Water Study in Pope County has been completed, and the Lake Emily (Pope County) and Pomme De Terre Sands (Big Stone, Chippewa, and Grant Counties) groundwater studies are in progress. Although groundwater supply is adequate, the projected demand for 115 mgd of irrigation water by 2020 is significant, and additional groundwater studies must be completed before an accurate assessment can be made. However, useful conclusions can be made as to which areas are probably not feasible to irrigate.

The areas shown in red and yellow on the map on page 77 generally would not support irrigation developments from on-site groundwater supplies. Irrigation in these areas would require large-scale development with water being supplied by import or from large water impoundments. The following map shows groundwater distribution in the basin.

AD-A119 415 CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT F/G 13/2
UPPER MINNESOTA RIVER SUBBASINS STUDY (PUBLIC LAW 87-639) (DRAF--ETC(U)
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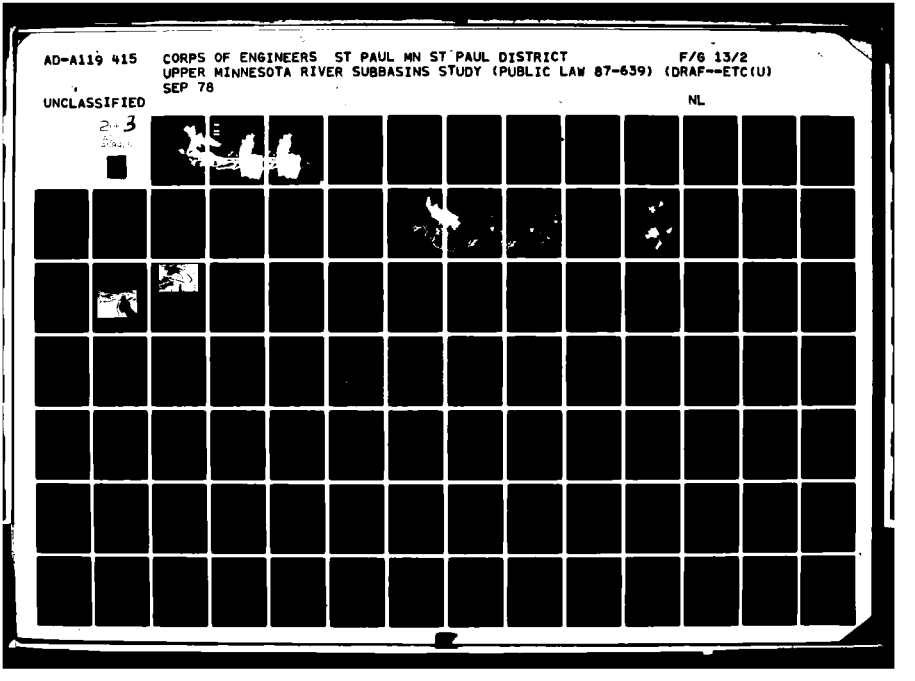
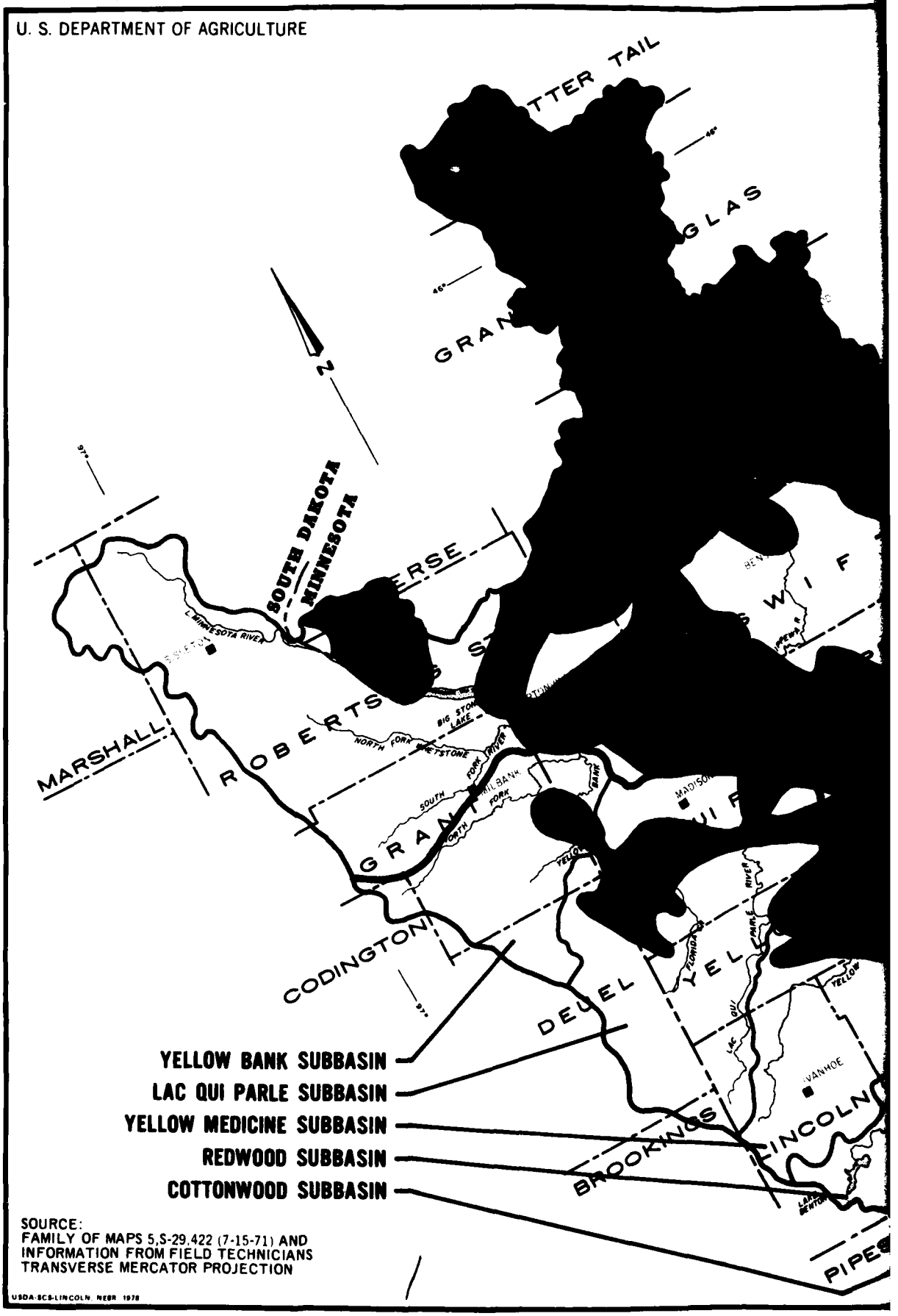


U. S. DEPARTMENT OF AGRICULTURE




SOURCE:
FAMILY OF MAPS 5,S-29,422 (7-15-71) AND
INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION

USDA-SCS-LINCOLN, NEBR. 1978

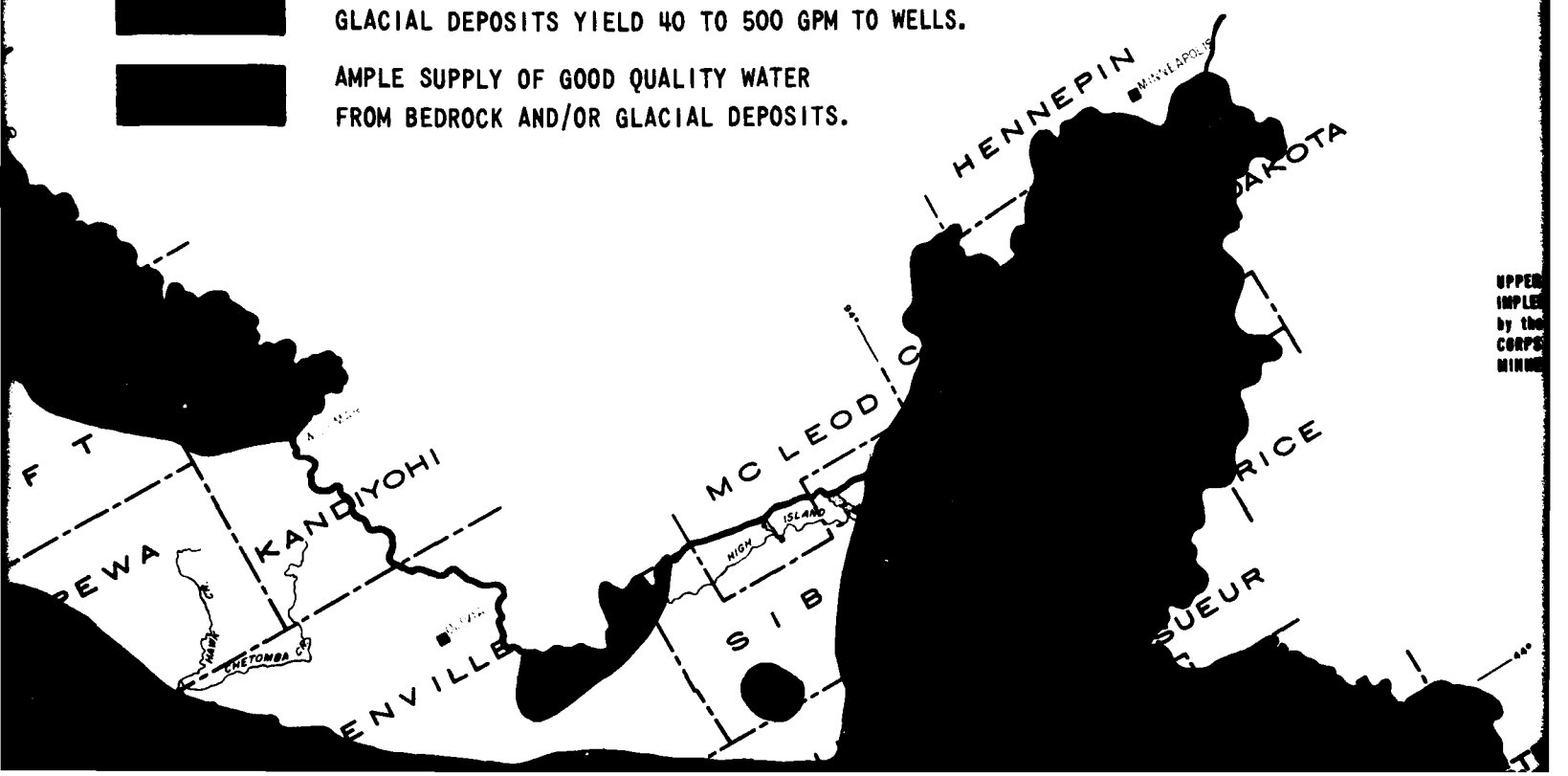
## LEGEND

BEDROCK WATER SUPPLIES ARE LOW. GLACIAL DEPOSITS GENERALLY YIELD LESS THAN 40 GPM TO WE

CRETACEOUS BEDROCK CONTAINS NONDEPENDABLE SUPPLIES OF POOR QUALITY WATER.
GLACIAL DEPOSITS YIELD LESS THAN 40 GPM TO WELLS.

CRETACEOUS BEDROCK CONTAINS NONDEPENDABLE SUPPLIES OF POOR QUALITY WATER.
GLACIAL DEPOSITS YIELD 40 TO 500 GPM TO WELLS.

AMPLE SUPPLY OF GOOD QUALITY WATER
FROM BEDROCK AND/OR GLACIAL DEPOSITS.



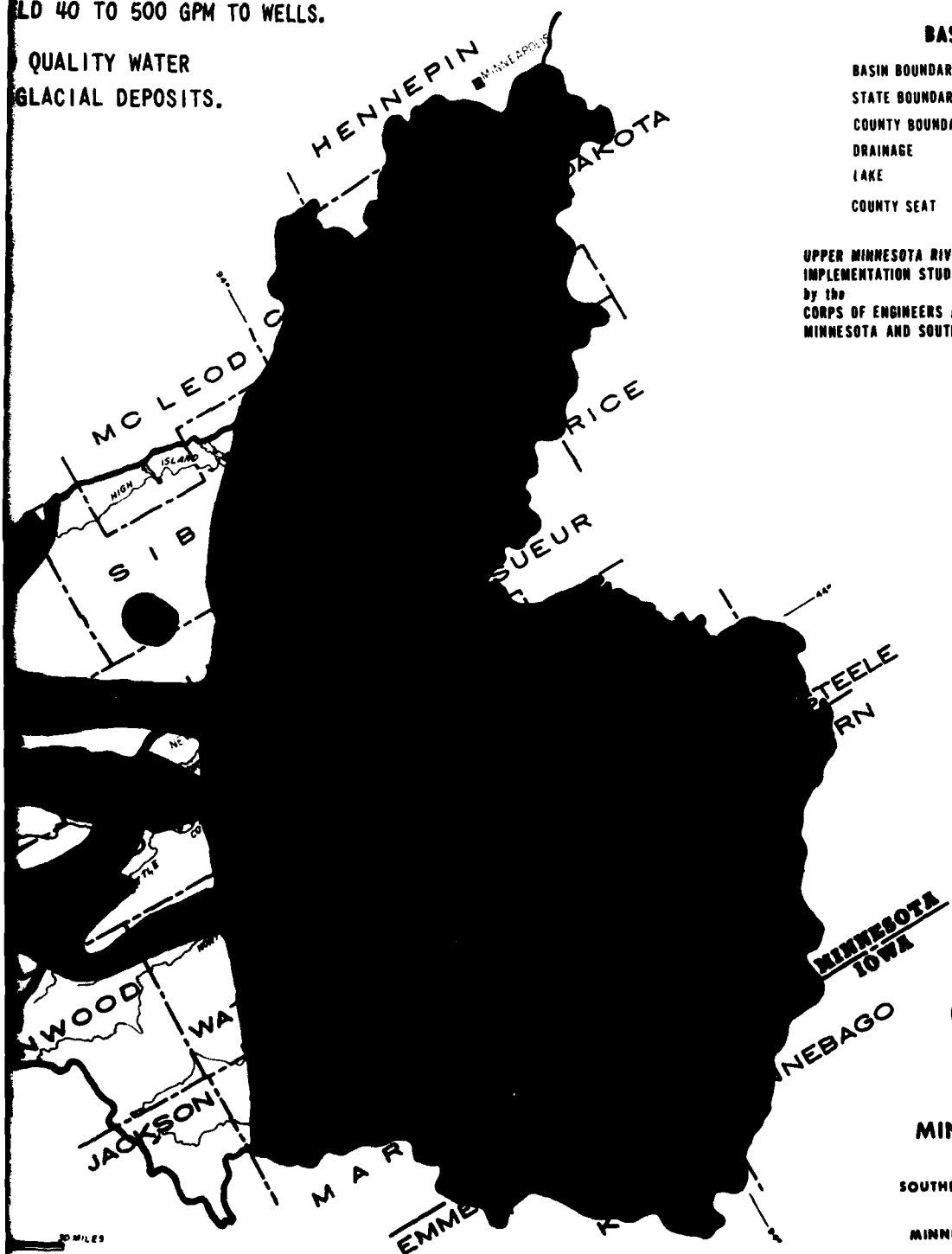
## LEGEND

ES ARE LOW. GLACIAL DEPOSITS GENERALLY YIELD LESS THAN 40 GPM TO WELLS.

ONTAINS NONDEPENDABLE SUPPLIES OF POOR QUALITY WATER.
LD LESS THAN 40 GPM TO WELLS.

ONTAINS NONDEPENDABLE SUPPLIES OF POOR QUALITY WATER.
LD 40 TO 500 GPM TO WELLS.

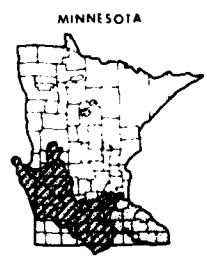
QUALITY WATER
GLACIAL DEPOSITS.




### BASE LEGEND

- BASIN BOUNDARY
- STATE BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE
- COUNTY SEAT

UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY
by the
CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE
MINNESOTA AND SOUTH DAKOTA




# GROUND WATER DISTRIBUTION MAP

## MINNESOTA RIVER BASIN

*portion of the*

SOUTHERN MINNESOTA RIVERS BASIN STUDY

MINNESOTA, SOUTH DAKOTA, AND IOWA

REV. 6-6-78
5,0-38,537

## WASTEWATER MANAGEMENT

Based on available information, a basin-wide analysis to identify a wastewater management plan should be undertaken. This plan should follow the broad outlines of the U.S. Environmental Protection Agency Section 208 Water Quality Planning. Detailed plans for specific urban areas should follow Section 201 of Public Law 92-500.

## PUBLIC HEALTH AND SAFETY

The health and safety of residents in the study area are directly affected during major flood periods. A serious threat to life is always present during floods as a result of flooded residences and related potential for drowning, electrical shocks, injurious falls, and injury during attempted movement over flooded thoroughfares. Other threats to public health include impedance of local traffic flow because of sight-seers, backup of sewers into basements, migration of vermin from flooded areas, contamination of private water supplies, a restricted degree of sewage treatment, the potential for a major fire caused by possible movement of the numerous fuel storage tanks and pipelines, and increased vector production during a major flood. An example of a vector problem is the mosquito and corresponding encephalitis problem.

## LAND USE

Land use should follow a logical pattern depending on the limitations of the soils. When there is a deviation from this pattern, problems are usually encountered that will require special construction techniques or management to correct.

No tremendous conflict exists between rural and urban land in the study area. Problems that result from scattered development are:

1. Conflicts between development and preservation of natural areas.
2. Loss of agricultural land to residential, commercial, and industrial development.
3. High cost of providing services for unguided urban growth.
4. Environmental impacts of development on unsuitable land.
5. Potential effects of higher energy cost on type and distribution of future urban/rural areas.
6. Erosion and sediment from developing areas.
7. Conversion of wildlife habitat to marginal agricultural land.

Some of the problems of the urban fringe areas are also prevalent in rural areas, especially where the intensive use of rural lands for agriculture is interfering with maintaining areas for environmental and ecological reasons. Other land use problems in rural areas are the production of crops on areas with steep and erosive slopes, wet soils, lack of conservation land treatment, overgrazed pastures that border streams and result in streambank erosion, and the production of crops in floodplains.

## SUMMARY

The following tables illustrate the specific needs by subbasin/county for water resource management in the study area as identified in the Type IV study.

Summary of needs, Brown County, Minnesota

| Need | Area | | | |
|---|---|---|---|---|
| | General | Big Cottonwood River | Little Cottonwood River | Milford Town Hall watershed[1] |
| Flood damage reduction and drainage | Need some on-farm drainage, group projects on Milford Town Hall and Mounds Creeks. Other outlets are established. | Minor flooding. | Annual flooding to intensively cropped but fairly narrow floodplain. | Flooding problem. |
| Irrigation | Three operators are irrigating 280 acres. The underground water supply is questionable. | | | |
| Recreation and fish and wildlife development | | | | Needs recreation.[1] |
| Erosion and sedimentation control | | | | |
| Lake improvement | Sleepy Eye Lake is being dredged. Boise Lake needs improvement. | | | |
| Water quality | Almost all lakes have algae problems. Water is "hard." | | | |
| Water supply | Sections 28 through 35 in Stately Township have a deficiency. Scattered agricultural areas throughout the county have problems. Sleepy Eye and New Ulm need more water to attract future industries. | | | |

(1) District Conservationist's priorities.

Summary of needs, Cottonwood County, Minnesota *

| Need | Area | | | | |
|---|---|---|---|---|---|
| | General | Dry Weather Creek (1) | Highwater Creek (3) | Mound Creek | Dutch Charley Creek (4) |
| Flood damage reduction (II) and drainage (III) | Drainage is needed on 45 percent of the land. Group projects are needed. Multipurpose projects are needed for Mound, Dry Weather, and Dutch Charley Creeks. Most floodplains are pasture with the main damage to roads and bridges. | Some flooding and break-over into Mound Creek. (1) Drainage improvement needed. | Moderate flood problem. | Flooding and drainage. | Moderate flood problem. Drainage needed. |
| Irrigation (VIII) | | | | | |
| Recreation (V) and fish and wildlife (VI) development | | | | Recreation needed. | Potential environmental corridor. |
| Erosion and sedimentation control (I) | Streambank erosion on all streams. | | | | |
| Lake improvement (IV) | Improvement needed on Bean, Double, and Long Lakes. | | | | |
| Water quality (VII) | | | | | |
| Water supply (IX) | | | | | |
| Other | Drainage laws should be updated. (2) | | | | |

* Numbers in parentheses denote District Conservationist's priorities. Roman numerals indicate priorities expressed in questionnaires from county commissioners and soil conservation district supervisors.

Summary of needs, Lac qui Parle County, Minnesota*

| Need | Area: General | CNI watershed: 8-22 | 8-23 | 8b-12 | 8b-07 | 8b-06 | 8b-09 (1) | 8b-10 | 8b-11 |
|---|---|---|---|---|---|---|---|---|---|
| Flood damage reduction (I) and drainage (II) | Group type (multi-purpose drainage is needed on all watersheds with flood problems. On-farm drainage and outlets needed on other lands (eastern portion of county). | -------- Severe flooding and impaired drainage ---------- | | | | | | | |
| Irrigation (IX) | None presently; questionable cost returns. | | | | | | | | |
| Recreation (V) and fish and wildlife (VI) development | Sections 23 and 30 of Maxwell Township needed for nesting refuge. Proposed wildlife area on Florida Creek. | | | | | | | | |
| Erosion and sedimentation control (IV) | Bank caving on county ditches. Sediment deposition in channels. | | | | | | | | |
| Lake improvement (VII) | Improvements needed on Salt, Peg, and Marsh Lakes and Lac qui Parle. | | | | | | | | |
| Water quality (III) | Water is hard throughout county. | | | | | | | | |
| Water supply (VIII) | No problems noted. | | | | | | | | |
| Other | Evaluation of wetlands acquisition needed. | | | | | | | | |

* Numbers in parentheses indicate District Conservationist's priorities. Roman numerals indicate priorities of county commissioners and soil conservation district supervisors.

Summary of needs, Lincoln County, Minnesota *

| Need | Area | | | | |
|---|---|---|---|---|---|
| | General | Yellow Medicine River (2) | Norwegian Creek (3) | Tyler Creek (4) | Lake Hendricks |
| Flood damage reduction (II) and drainage (I) | All types of drainage are needed. | ----Flooding and impaired drainage---------- | | | Outlet problem. |
| Irrigation | One irrigator. Lack of dependable water supply. | | | | |
| Recreation (V) and fish and wildlife (IV) development | | ----------Improvement needed---------- | | | |
| Erosion and sedimentation control (III) | | ----------Needed---------- | | | |
| Lake improvement | Lake Benton and Shoakatan Lake have algae problem and are polluted. | | | | |
| Water quality | "Hardness" throughout county. | | | | |
| Water supply | No problem noted. | | | | |
| Other | Proper land use is needed for area. (1)<br>Wetlands acquisition should be evaluated. (1) | | | | |

* Numbers in parentheses indicate District Conservationist's priorities. Roman numerals indicate priorities determined by county commissioners and soil conservation district supervisors.

Summary of needs, Lyon County, Minnesota*

| Need | General | Area | | | | |
|---|---|---|---|---|---|---|
| | | Upper Yellow Medicine River(1) | Three Mile Creek(1) | Tyler Creek(1) | Redwood River(2) | Meadow Creek |
| Flood damage reduction (I) and drainage (III) | Multipurpose drainage is needed where flooding is mentioned. On-farm drainage is needed for the rest of the county. | ----------Both are needed---------- | | | | |
| Irrigation | None at present. Water source is questionable. Questionable cost returns for field crops. | | | | | |
| Recreation (V) and fish and wildlife (VI) development | | ----------Some interest shown---------- | | | | |
| Erosion and sedimentation control (IV) | | ----------Siltation in channels---------- | | | | |
| Lake improvement (VI) | Cottonwood, School Grove, West Twin, and Goose Lakes need improvement. | | | | | |
| Water quality (II) | "Hardness" throughout county. | | | | | |
| Water supply (VIII) | No problem noted for present use levels. | | | | | |
| Other | Wetlands acquisition should be evaluated. | | | | | |

* Numbers in parentheses indicate District Conservationist's priorities. Roman numerals indicate priorities determined by county commissioners and soil conservation district supervisors.

Summary of needs, Murray County, Minnesota *

| Need | Area | | |
|---|---|---|---|
| | General | Plum Creek | Redwood River |
| Flood damage reduction and drainage | Multipurpose project needed on Redwood River. Remainder of drainage is on-farm. | Mainly drainage needs. (1) | Drainage versus wildlife land use controversy. |
| Irrigation | None in basin. No good water source. | | |
| Recreation and fish and wildlife development | | Interested. | Interested. |
| Erosion and sedimentation control (II) | Problem is normal for region. | | |
| Lake improvement | No need listed. | | |
| Water quality (I) | No problem noted. | | |
| Water supply | No problem noted. | | |
| Other | Wetlands acquisition should be evaluated. | | |

* Numbers in parantheses indicate District Conservationist's priority. Roman numerals indicate priorities determined by county commissioners and soil conservation district supervisors.

Summary of needs, Pipestone County, Minnesota

| Need | Area | | |
|---|---|---|---|
| | General | Headwaters of Redwood River | Tyler Creek |
| Flood damage reduction | One multiple-purpose drainage project needed. Remainder is on-farm drainage. | Multiple-purpose drainage project needed. (1) | Both are needed. |
| Irrigation | None. | | |
| Recreation and fish and wildlife development | | | Potential fish and wildlife site. (2) |
| Erosion and sedimentation control | | Needed. | Needed. |
| Lake improvement | No need noted. | | |
| Water quality | "Hardness" in this area. | | |
| Water supply | No problem noted. | | |
| Other | Wetlands acquisition should be evaluated. | | |

(1), (2) - Priorities assigned by District Conservationist.

Summary of needs, Redwood County, Minnesota *

| Need | Area | | | | |
|---|---|---|---|---|---|
| | General | Redwood Falls and Redwood River | Ramsey Creek | Minnesota River | Sleepy Eye Creek |
| Flood damage reduction and drainage | Almost all needed group drainage projects are completed. Some on-farm drainage is needed. | Slight flooding problem. | Slight flooding problem. | Minnesota River floodplain | Slight flooding problem. |
| Irrigation | Six in operation. Questionable cost returns. | | | | |
| Recreation (III) and fish and wildlife (IV) development | | Potential environmental corridors. (1) | | Could be developed as environmental corridor. | |
| Erosion and sedimentation control (I) | | | Moderate bank erosion. | | Bank erosion. |
| Lake improvement | | | | | |
| Water quality (II) | "Hard" water throughout county. | Redwood River is polluted. (2) | | | |
| Water supply | Sections 16 through 22 of Charlestown Township lack dependable water supplies. | Industrial expansion may be limited. | | | |

* Numbers in parentheses indicate District Conservationist's priorities. Roman numerals indicate priorities determined by county commissioners and soil conservation district supervisors.

Summary of needs, Yellow Medicine County, Minnesota *

| Need | General | Area | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Canby Creek watershed(1) | Lac qui Parle Creek(2) | Lac qui Parle River(2) | Yellow Medicine River(2) | Florida Creek(2) | Lazarus Creek(2) | Mud Creek(2) | Spring Creek(2) | Minnesota River valley (3) |
| Flood damage reduction (I) and drainage (II) | Need multipurpose drainage projects on all seven flood areas and Hanley Falls Creek and St. Leo on the west. On-farm drainage in eastern part of county. | Both are needed. | ---------- | ---------- | Severe flooding and impaired drainage | ---------- | ---------- | ---------- | ---------- | ---------- |
| Irrigation (VIII) | None practiced. Questionable cost returns. | | | | | | | | | |
| Recreation (VI) and fish and wildlife (IV) development | | Needed. | | | | | | | | Potential for environmental corridors. |
| Erosion and sedimentation control (III) | | Needed. | ---------- | ---------- | ---------- | Channel sedimentation | ---------- | ---------- | ---------- | ---------- |
| Lake improvement | Improvement needed at Miedd(3) and Spellman Lakes. | | | | | | | | | |
| Water quality (V) | "Hardness" is a problem throughout the country. | | | | | | | | | |
| Water supply (VII) | Need water supply in the St. Leo area. (4) | | | | | | | | | |
| Other | Wetlands acquisition should be evaluated. (5) | | | | | | | | | |

* Numbers in parentheses indicate District Conservationist's priorities. Roman numerals indicate priorities determined by county commissioner and soil conservation district supervisors.

Summary of needs, Deuel and Brookings Counties, South Dakota

| Need | Area | | | | |
|---|---|---|---|---|---|
| | General | Cobb-Florida watershed(1) | Yellow Bank River(2) | Oak Lake and Lake Hendricks, Brookings County | Fish Lake and Lake Cochrane, Deuel County |
| Flood damage reduction and drainage | Small group type drainage needed along Lac qui Parle River and Mud Creek. Multi-purpose drainage projects needed for the Cobb-Florida watershed. Other drainage needed is on-farm. | Need both. | Need both. | | |
| *Irrigation* | *Possible area near Gary.* | | | | |
| Recreation and fish and wildlife development | | Possible conflict with drainage. | | | |
| Erosion and sedimentation control | Normal needs for area. | | | | |
| Lake improvement | | | | Needed. | Needed. |
| Water quality | No major problems in Deuel County. | | | | |
| Water supply | No problems noted. | | | | |
| Other | Wetlands acquisition should be evaluated.(3) | | | | |

(1), (2), (3) Indicate District Conservationist's priorities.

Summary of needs, Grant and Codington Counties, South Dakota

| Need | Area | | |
|---|---|---|---|
| | General | Mud Creek | Yellow Bank River (1) |
| Flood damage reduction and drainage | Drainage needed is mostly on farm. | Under construction. | Both flooding and drainage problems; mostly flooding. |
| Irrigation | None; lack of irrigable soils. | | |
| Recreation and fish and wildlife development | | | Some interest expressed. |
| Erosion and sedimentation control | Normal problems along face of Coteau. | | Needed. |
| Lake improvement | No need noted. | | |
| Water quality | "Hardness" throughout area. Streams are becoming polluted. | | |
| Water supply | La Bolt and Albee have no municipal supply. Milbank may have future need. | | |
| Other | Wetlands acquisition should be evaluated. Agassiz Basin Resource Conservation and Development project should be established. (2) | | |

(1), (2) Denote District Conservationist's priorities.

# EXISTING PROJECTS AND PROGRAMS

## INTRODUCTION

Opportunities for solving identified problems and meeting anticipated needs through Federal, State, and local agencies and programs are presented in this chapter. Although service is available through these agencies, the initial requirement for assistance generally rests with the residents and landowners in the basin. Properly understood and used, these programs represent a valuable resource upon which local units can draw for the solutions of community problems and attainment of community goals. Land treatment measures, such as terraces, waterways, and the establishment of grass or trees, will be accomplished only when the individual landowner is motivated to do so. Other measures, such as floodwater retardation, municipal and industrial water supply, or public recreation facilities or structures, require group or community action. Land treatment measures, when combined with a structural program, provide an integrated watershed management program.

There is also a continuing program to inform landowners of the assistance available from these agencies so that they may select the combination of programs that best meets their needs and desires. The public involvement program will acquaint the public with the objectives of this study.

## FEDERAL AGENCIES

### U.S. Department of Agriculture (USDA)

Public Law 46. - This law established the Soil Conservation Service (SCS) and made it responsible for developing and carrying out a national program of conservation and development of land and water resources.

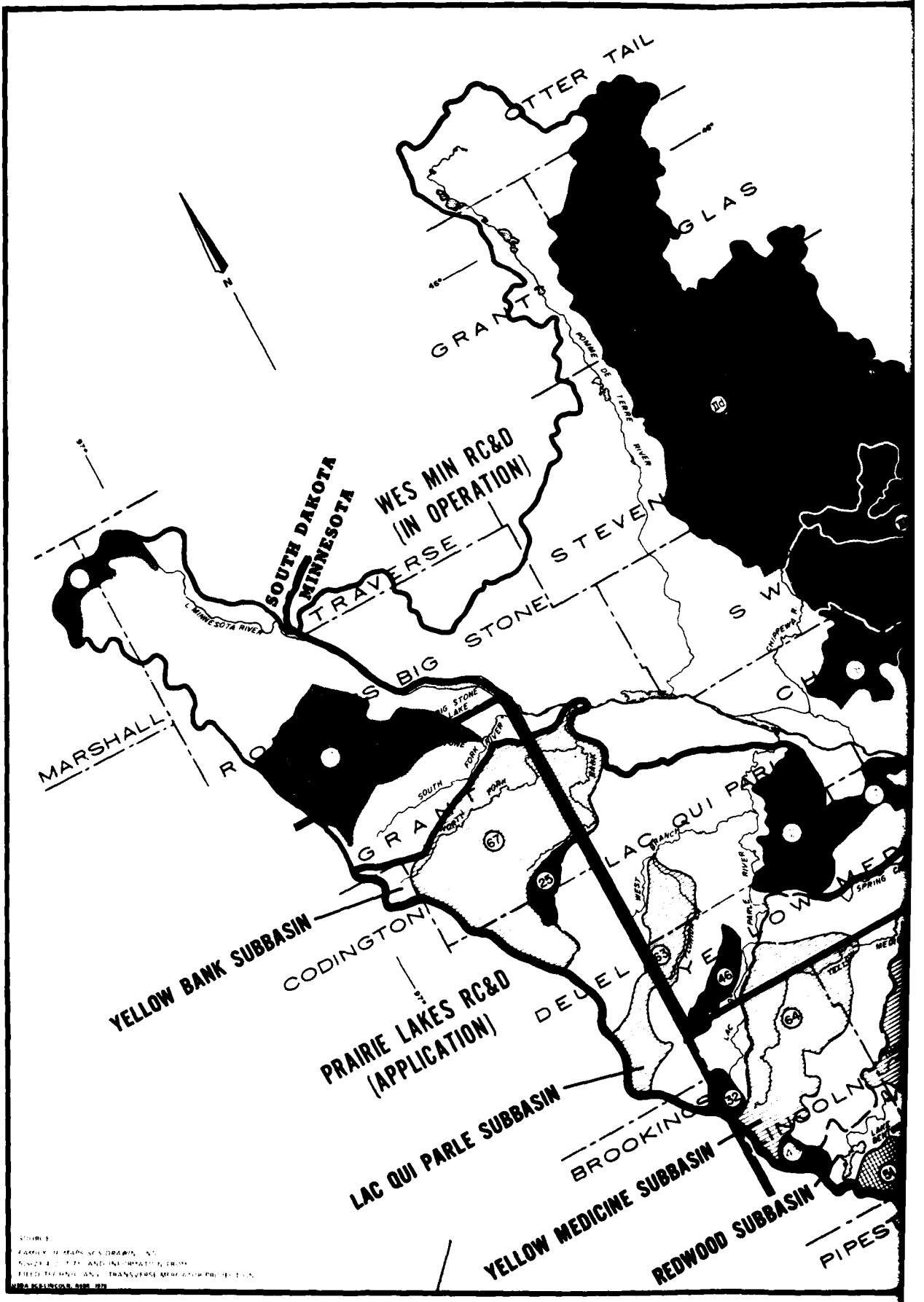
The SCS has an objective of integrating the planning of land use and installation of conservation treatment in harmony with the capability and needs of the land. To accomplish this, SCS employs scientists and technologists from many disciplines to diagnose land and water resource problems and prescribe successful treatment and use.

Most of the on-the-land SCS assistance to landowners is channeled through local soil and water conservation districts. Some of the conservation practices on which the SCS has offered technical assistance in the basin include :

| | |
|---|---|
| Conservation cropping systems | Grass waterways |
| Critical area planting | Minimum tillage |
| Drainage field ditches | Pasture and cropland management |
| Grade stabilization structures | Crop residue use |
| Tile drains | Terraces |
| Fish pond management | Land grading |
| Farm ponds | Animal waste control systems |

These measures have solved numerous erosion, sediment, and drainage problems in the basin and have resulted in increased agricultural yields and reduction in crop damages. Many areas in the basin still have land and water resource problems, and additional work to apply more conservation practices must be undertaken.

The SCS also administers the Soil Survey Program which surveys the soil resources for the Nation. This program examines soils in the field and in laboratories; describes and classifies; maps kinds of soils; interprets soils according to their adaptability for various crops, grasses, and trees; studies their behavior under use or treatment for plant production or other purposes; and evaluates their productivity under different management systems. See the following figure for the status of this activity.


OTTER TAIL
GRANT
TRAVERSE
STEVENS
BIG STONE
MARSHALL
GRANT
LAC QUI PARLE
CODINGTON
DEUEL
BROOKINGS
LINCOLN
SOUTH DAKOTA
MINNESOTA
WES MIN RC&D
(IN OPERATION)
PRAIRIE LAKES RC&D
(APPLICATION)
YELLOW BANK SUBBASIN
LAC QUI PARLE SUBBASIN
YELLOW MEDICINE SUBBASIN
REDWOOD SUBBASIN
MINNESOTA RIVER
POMME DE TERRE RIVER
BIG STONE LAKE
SOUTH FORK
NORTH FORK
WEST BRANCH
EAGLE RIVER
SPRING CR.
LAKE BENTON
PIPESTONE

## WATERSHED KEY

### PILOT WATERSHEDS

III. CHIPPEWA RIVER TRIBUTARIES AND HAWK CREEK

(a) SHAKOPEE RIVER
(b) MUD CREEK
(c) HAWK CREEK
(d) UPPER CHIPPEWA

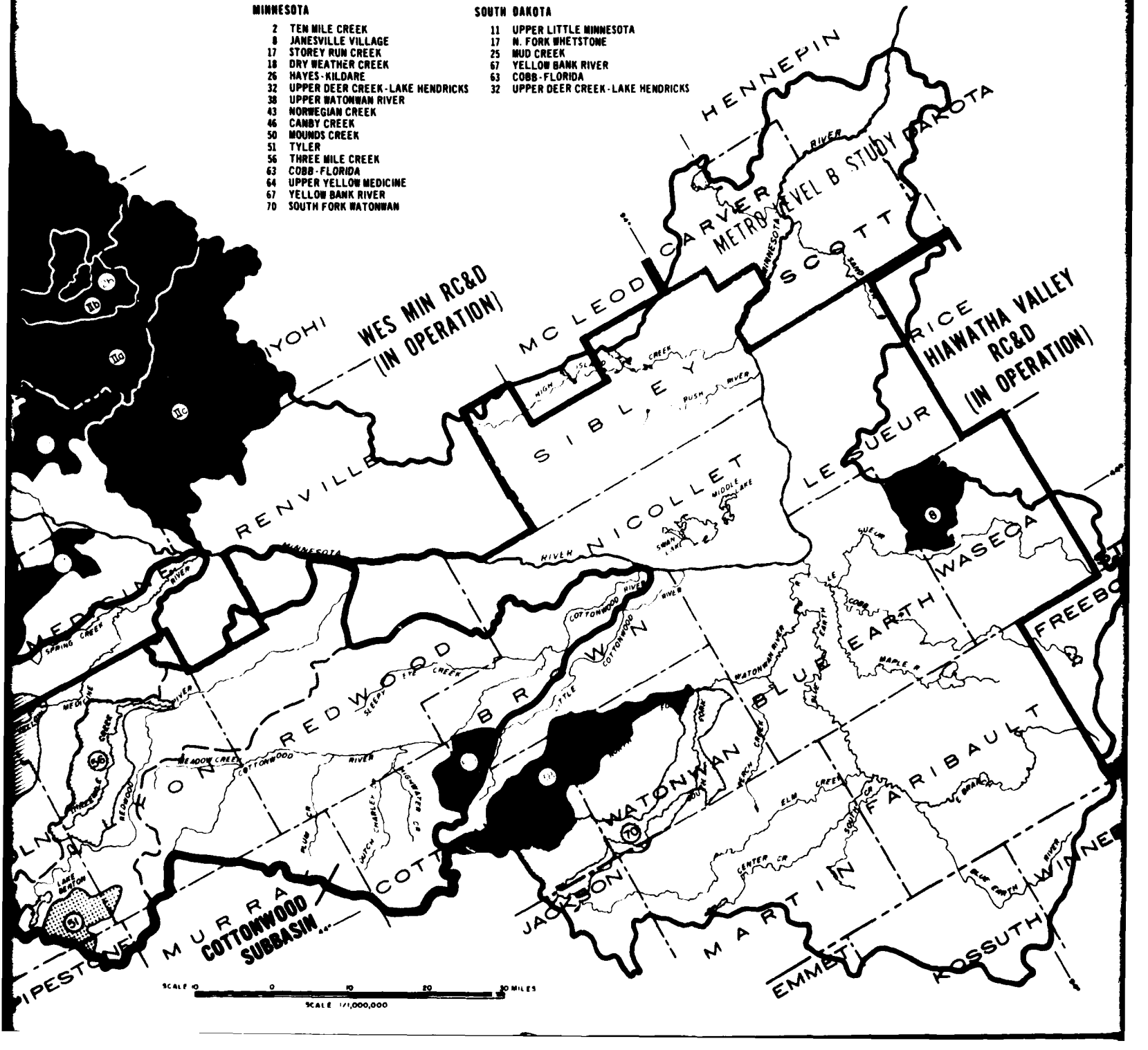
### 566 WATERSHEDS

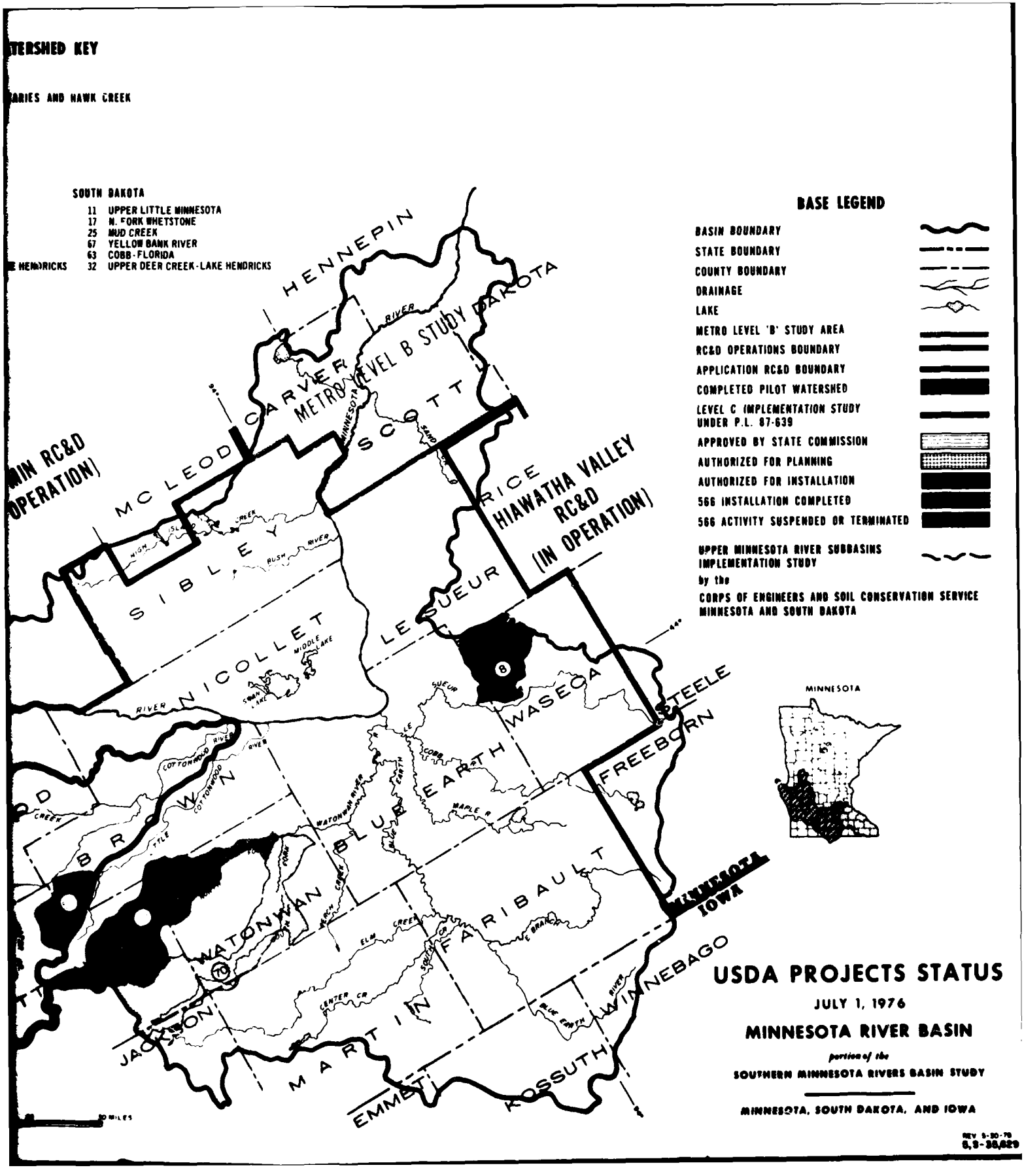
**MINNESOTA**

2 TEN MILE CREEK
8 JANESVILLE VILLAGE
17 STOREY RUN CREEK
18 DRY WEATHER CREEK
26 HAYES-KILDARE
32 UPPER DEER CREEK-LAKE HENDRICKS
38 UPPER WATONWAN RIVER
43 NORWEGIAN CREEK
46 CANBY CREEK
50 MOUNDS CREEK
51 TYLER
56 THREE MILE CREEK
63 COBB-FLORIDA
64 UPPER YELLOW MEDICINE
67 YELLOW BANK RIVER
70 SOUTH FORK WATONWAN

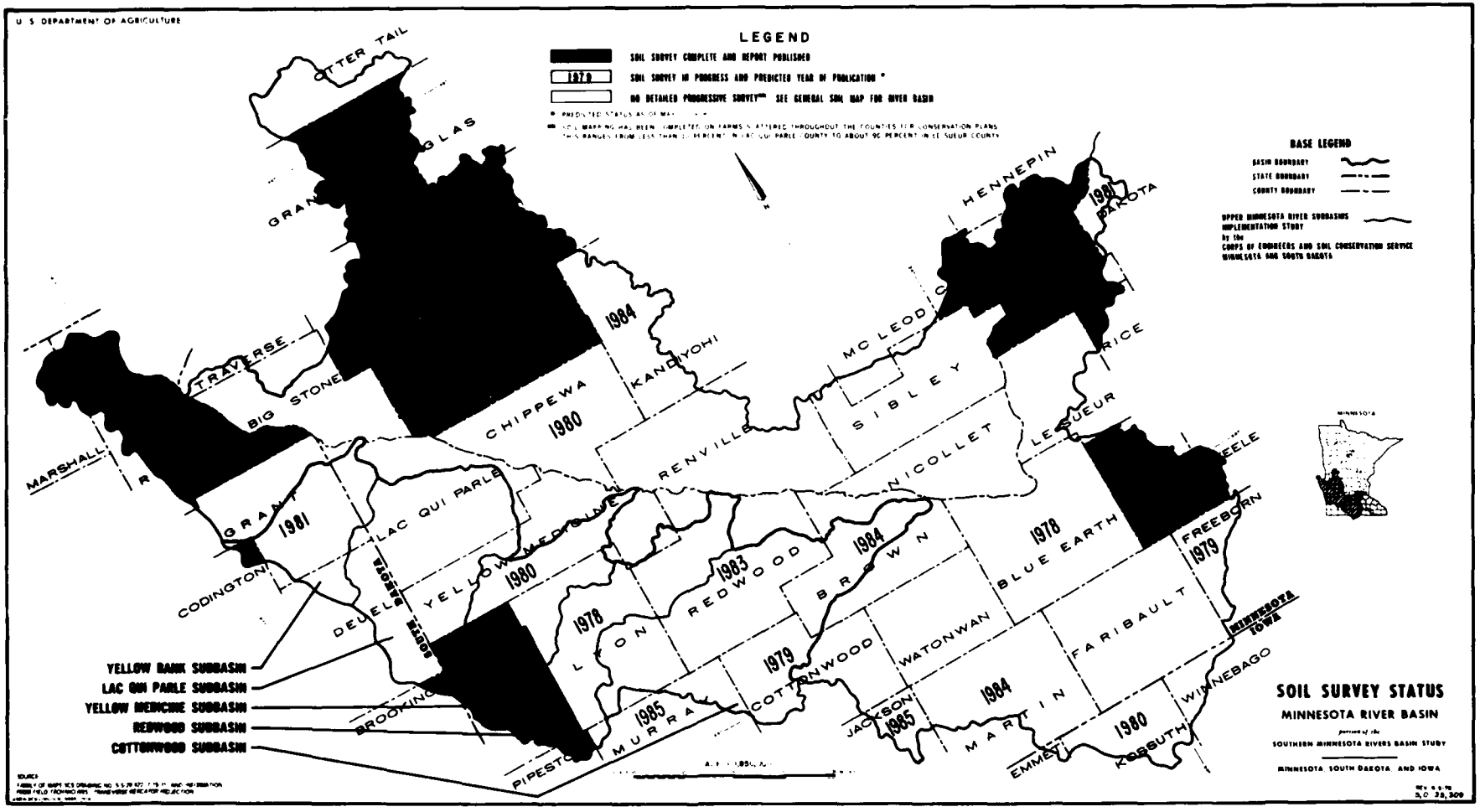
**SOUTH DAKOTA**

11 UPPER LITTLE MINNESOTA
17 N. FORK WHETSTONE
25 MUD CREEK
67 YELLOW BANK RIVER
63 COBB-FLORIDA
32 UPPER DEER CREEK-LAKE HENDRICKS




TERSHED KEY
ARIES AND HAWK CREEK
SOUTH DAKOTA
11 UPPER LITTLE MINNESOTA
17 N. FORK WHETSTONE
25 MUD CREEK
67 YELLOW BANK RIVER
63 COBB-FLORIDA
E HENDRICKS 32 UPPER DEER CREEK-LAKE HENDRICKS
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
DRAINAGE
LAKE
METRO LEVEL 'B' STUDY AREA
RC&D OPERATIONS BOUNDARY
APPLICATION RC&D BOUNDARY
COMPLETED PILOT WATERSHED
LEVEL C IMPLEMENTATION STUDY UNDER P.L. 87-639
APPROVED BY STATE COMMISSION
AUTHORIZED FOR PLANNING
AUTHORIZED FOR INSTALLATION
566 INSTALLATION COMPLETED
566 ACTIVITY SUSPENDED OR TERMINATED
UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY
by the
CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE
MINNESOTA AND SOUTH DAKOTA
MIN RC&D OPERATION)
HENNEPIN
CARVER
METRO LEVEL B STUDY
DAKOTA
SCOTT
MC LEOD
SIBLEY
RICE
HIAWATHA VALLEY RC&D (IN OPERATION)
LE SUEUR
NICOLLET
WASECA
STEELE
FREEBORN
BROWN
BLUE EARTH
FARIBAULT
WATONWAN
MARTIN
JACKSON
EMMET
KOSSUTH
WINNEBAGO
MINNESOTA
IOWA
MINNESOTA
USDA PROJECTS STATUS
JULY 1, 1976
MINNESOTA RIVER BASIN
portion of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA, AND IOWA
REV 9-20-76
8,9-38,829

When available, this information is valuable in the selection of building sites, production of crops, location of recreation development, and many other undertakings where the soils will have a major effect. The following figure shows the status of the soil curvey in the Minnesota River basin.


U S DEPARTMENT OF AGRICULTURE
LEGEND
SOIL SURVEY COMPLETE AND REPORT PUBLISHED
1979
SOIL SURVEY IN PROGRESS AND PREDICTED YEAR OF PUBLICATION *
NO DETAILED PROGRESSIVE SURVEY*** SEE GENERAL SOIL MAP FOR RIVER BASIN
BASE LEGEND
BASIN BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY by the CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE MINNESOTA AND SOUTH DAKOTA
OTTER TAIL
GRANT
TRAVERSE
BIG STONE
MARSHALL
CODINGTON
DEUEL
BROOKINGS
PIPESTONE
MURRAY
LAC QUI PARLE
YELLOW MEDICINE
LINCOLN
LYON
REDWOOD
COTTONWOOD
JACKSON
EMMET
KOSSUTH
CHIPPEWA
KANDIYOHI
RENVILLE
MC LEOD
SIBLEY
NICOLLET
HENNEPIN
DAKOTA
RICE
LE SUEUR
BROWN
WATONWAN
MARTIN
BLUE EARTH
FARIBAULT
FREEBORN
STEELE
WINNEBAGO
MINNESOTA
IOWA
1984
1980
1981
1980
1978
1983
1984
1979
1985
1985
1984
1980
1978
1979
YELLOW BANK SUBBASIN
LAC QUI PARLE SUBBASIN
YELLOW MEDICINE SUBBASIN
REDWOOD SUBBASIN
COTTONWOOD SUBBASIN
SOIL SURVEY STATUS
MINNESOTA RIVER BASIN
pursued of the
SOUTHERN MINNESOTA RIVERS BASIN STUDY
MINNESOTA, SOUTH DAKOTA AND IOWA

Public Law 566. - Under this program, technical and financial assistance to State and local organizations is provided for planning, designing, and installing watershed works of improvement. Cost-sharing is provided for flood prevention, irrigation, drainage, sedimentation control, fish and wildlife development, and public recreation. Long-term credit can be obtained by local interests for their share of the cost. This program provides a means of solving watershed protection and flood prevention problems which cannot be adequately met by other ongoing programs. It is administered by the SCS.

Currently, 13 Public Law 566 projects in the basin are at various stages of development. The status of these projects is shown on the USDA Project Status Map on page 93.

The Forest Service is responsible for the forestry phase of Public Law 566 watershed projects and soil and water conservation applicable to land used for forestry purposes.

RC&D (Resource Conservation and Development) projects. - The RC&D program was authorized by the Foood and Agriculture Act of 1962. It expands opportunities for conservation districts, local units of government, and individuals to improve their communities in multicounty areas. To carry out the program, financial and technical assistance may be provided to sponsors in carrying out eligible measures having community benefits, such as:

1. Critical area treatment (erosion and sediment control).
2. Flood prevention using:
   a. Structures.
   b. Land stabilization.
3. Public water-based recreation developments.
4. Public water-based fish and wildlife developments.
5. Farm irrigation.
6. Land drainage.
7. Soil and water management for agricultural related pollutant control.
8. Accelerated services.

The study area includes one RC&D project - the WesMin RC&D project. It encompasses all or parts of Yellow Medicine and Lac qui Parle Counties in the northern portion of the study area. An application has been made for the Prairie Lake RC&D project in South Dakota. It will include parts of three counties within the basin. See figure on page 93.

The SCS has leadership in this program. Assistance is provided where acceleration of ongoing programs of resource conservation, development, and utilization will increase economic opportunities for local people.

Clarke-McNary Act. - Professional and financial assistance is provided to States for fire protection on non-Federal forest land. The States administer the protection programs and are reimbursed from Federal funds up to 50 percent of expenditure. Federal participation includes services such as assistance in training personnel, development and procurement of better fire equipment and tools, preparation of fire plans, and direction of the nationwide forest fire protection program.

Cooperative Forest Management Act of 1950. - States are provided financial and technical assistance to assist private forest landowners in practicing multiple-use forest management. The cooperative forest management program is administered by the State and reimbursed from Federal funds on a cost-sharing basis. Private forest landowners are provided on-the-ground technical assistance by professional foresters employed by the State.

States may also receive financial and professional assistance for sawmill operators and other processors of forest products for improved logging, processing and manufacturing techniques; marketing information; and safety.

Farmers Home Administration. - This Department of Agriculture agency administers many programs available to landowners and rural communities. Among the services are:

1. Emergency loans.
2. Farm ownership loans.
3. Financial assistance to small towns and rural groups.
4. Loans and grants for farm labor housing.
5. Loans for forestry purposes.
6. Loans for recreation purposes.
7. Loans to rural families with low incomes.
8. Operating loans.
9. Rental loans.
10. Rural housing loans.
11. Rural renewal loans.

Of particular importance in the basin are farm ownership loans, financial assistance to small towns and rural groups, and loans for recreational purposes. Farm ownership loans are used for a variety of purposes, including providing basic soil treatment and land conservation measures as well as providing necessary water and water facilities. Also of significance is the program which provides financial assistance to small towns and rural groups and makes loans and grants to public and nonprofit organizations which primarily serve rural areas to plan and develop domestic water supply and waste disposal systems. Loans are provided to operators or managers of family farms to develop land and water resources; repair and construct buildings; purchase land, equipment, and related recreational items; and pay necessary operating expenses.

These programs can assist financially in solving major sediment and erosion problems, as well as providing municipal water, waste disposal systems, and recreational facilities.

ASCS (Agricultural Stabilization and Conservation Service. - The ASCS administers several Department of Agriculture programs. One of these, the ACP (Agriculture Conservation Program) provides cost-sharing assistance to agricultural producers who undertake soil, water, forestry, and wildlife conservation practices on farmlands currently in agricultural production. The cost of such practices is shared between the Federal Government and the agricultural producer.

Technical assistance for ACP practices is rendered by the SCS and the Extension Service. This program can serve as a valuable tool in solving the erosion and sediment problems and meeting the other resource needs in the basin through the establishment of conservation practices.

Public Law 87-639. - This law authorizes the Secretary of the Army and the Secretary of Agriculture to make joint investigations and surveys of watershed areas for flood prevention or the conservation, development, use, and disposal of water. Reports are made jointly on such surveys and investigations and submitted jointly to the Congress for approval. Funds are appropriated, as necessary, to carry out the purpose of this act. This study has been authorized under Public Law 87-639 for the study area.

Extension Service. - The Extension Service's basic job is to help people identify and solve their farm, home, and community problems through the use of research findings of the Department of Agriculture, the University of Minnesota, and programs administered by the Department of Agriculture. The Extension Service is very active in the basin in helping local people solve many of their resource problems through its educational programs.

U.S. Army Corps of Engineers

Flood Control Act of 1936. - This act and a resolution approved 10 May 1962 authorized a Minnesota River basin survey with a view toward determining the advisability of further improvements in the basin for

navigation, flood control, recreation, low-flow augmentation, and other related purposes. Continued study and interagency coordination is maintained. The study is scheduled for completion in 1981.

Flood Control Act of 1960. - A local flood protection project on the Redwood River at Marshall, completed in December 1963, included channel improvement, a diversion channel, two drop structures, four new railroad bridges, and five new highway bridges across the diversion channel (see the following photographs). A current study to extend protection upstream of the diversion channel, control crossover flood flows to the Cottonwood River basin, and increase the overall protection provided by the existing project is scheduled for completion in June 1978.

Looking upstream at the diversion channel on the Redwood River at Marshall, Minnesota

Looking downstream at the diversion channel on the Redwood River at Marshall, Minnesota

Flood Control Act of 1948. - A local flood protection project on the Yellow Medicine River at Minneota, Minnesota, completed in May 1963, included a levee, channel improvement, a creek diversion ditch, culverts, sewer outfall, sandbag closures, and a new highway bridge constructed by local interests.

Floodplain Information Report. - A floodplain information report was prepared for Marshall, Minnesota, in 1974-75. The report provides reliable flood information needed to implement floodplain management practices required by Minnesota's Flood Plain Management Act.

## Heritage Conservation and Recreation Service

This agency has responsibility for providing outdoor recreation areas and facilities on areas designated as State parks, State preserves, and natural lakes. It reviews all outdoor recreation plans prepared for county conservation boards and municipalities for participation in the land and water conservation fund program. It also reviews projects submitted by agencies for Federal funding assistance and is responsible for reviewing cultural resources investigations and determining which cultural resources are to be included on the National Registers of Historic Places and Natural Landmarks.

## National Weather Service

The National Weather Service is responsible for issuing flood warnings and advisory forecasts. There are 13 locations that issue forecasts based on observed precipitation and stages at upstream points and anticipated weather conditions. The forecasts are distributed to the media for public information.

## U.S. Department of Housing and Urban Development, Federal Insurance Administration

This agency investigates flood hazards at locations specified by the State to aid in administration of the Flood Insurance Ict of 1978 and the Flood Disaster Protection Act of 1973.

## Environmental Protection Agency

This agency is responsible for study and development of quality standards for classification of Minnesota waters.

## U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service is responsible under law for the preservation, management, and enhancement of the Nation's fish and wildlife resources. The management of migratory birds and nationally endangered species is a primary Federal responsibility; the management of resident fish and wildlife is a principal State responsibility. To carry out the goal of preservation and enhancement of the Nation's fish and wildlife resources, the Fish and Wildlife Service works toward minimizing adverse impacts on these resources as a result of local, State, and Federal land and water resource development programs.

STATE AGENCIES

Department of Natural Resources

This department is assigned the responsibility of conserving and promoting the wise use and management of the natural resources of the State.

Principal responsibilities are to:

1. Provide management assistance to private owners of forest land.
2. Acquire, develop, and maintain State parks, recreation areas, canoe and boat routes, wild and scenic rivers, trail systems, and wildlife management areas.
3. Protect and manage the State's wildlife and fisheries resources to assure sustained yields and research to uncover new management methods and an ample supply of game and nongame wildlife and fish for Minnesotans.
4. Provide administrative leadership and guidance to the locally organized soil and water conservation districts.
5. Manage State-owned forest land.
6. Carry out State-local cooperative programs for management of floodplain and shoreland areas.
7. Administer the use, allocation, and control of public waters.

Minnesota Pollution Control Agency

This agency has the responsibility for adopting standards and regulating the discharge of pollutants into the water, air, and land resources of the State.

Southern Minnesota Rivers Basin Board

The board has responsibilities as described on page 1.

## Water Resources Board

The board has the jurisdiction, power, and authority to establish watershed districts and to define and fix their boundaries. A watershed district may be established upon filing of a nomination petition.

## Soil and Water Conservation Board

This Board provides assistance to soil and water conservation districts. The Board administers the new $3 million cost-sharing program through the Soil and Water Conservation Districts for permanent practices to control soil erosion. The Board also administers the State construction program which consists of financial assistance to counties, watershed districts, and Soil and Water Conservation Districts for project and construction costs of floodwater retarding and retention structures. The Minnesota Legislature appropriated $250,000 in fiscal year 1976-77 and about $540,000 in fiscal year 1978-79.

## Minnesota Geological Survey

The Geological Survey is responsible for conducting geologic investigations in Minnesota. An essential part of its responsibility is to provide the geologic data needed to evaluate the State's groundwater resources. The survey was established by an act of the State Legislature and is administered under the Board of Regents of the University of Minnesota.

## State Water Planning Board

This board has responsibility for coordinating State agency involvement in water resource planning and development.

## LOCAL GOVERNMENT AGENCIES

### Soil and Water Conservation Districts

These districts are legally constituted units of State government created to administer soil and water conservation work within their boundaries. They sponsor or cosponsor most watershed protection and flood prevention and resource conservation and development projects. By virtue of their broad activities, districts have an important role in the development of rural areas.

The districts focus attention on land and water problems, develop annual and long-range programs designed to solve problems, and enlist all the appropriate, available help from public and private sources that will contribute to the accomplishment of the districts' goals.

### Watershed Districts

Watershed districts are legally constituted units of State government created to administer water resources improvements within their boundaries. They cosponsor watershed protection and flood prevention and resource conservation and development projects. They have powers of taxation and eminent domain and oversee the maintenance and care of existing water resources projects.

# IMPROVEMENTS DESIRED

## INTRODUCTION

Many meetings have been held by various Federal and State agencies and local interest groups throughout the basin to discuss the water and related resource problems in the area. The needs and desires of interested people have been expressed at these meetings. A considerable amount of time, effort, and concern has already been expended to achieve

at least a partial solution to the area's problems. However, as evidenced by the continued problems throughout the basin, it is necessary to develop a fully coordinated overall water and related resource plan to satisfy the existing and projected needs of the basin. The area II Action Committee, in conjunction with the Watershed Districts, Soil and Water Conservation Districts and County Boards, is currently involved in the study and will establish the eventual priority for implementation of measures to solve the most severe problems in the study area.

## LOCAL SPONSORS

Needs identified by the local people and the policy committee (Type IV study) which represents local citizens are grouped into five general priority categories:

1. Flood damage reduction.
2. Improved drainage on agricultural lands.
3. Erosion control.
4. Pollution abatement.
5. Recreation and fish and wildlife improvements and developments.

In recent years, consideration for the environment has become a major objective in resource planning. Because of this concern for the environment by a variety of citizens and groups, planners must explore available alternatives that not only have economic benefits, but environmental benefits as well.

Other concerns relate to changing public demands and emphasis which are shifting toward programs that will provide for a quality environment in which to live and grow. In developing new public programs, planners and legislators should consider these shifts in values.

Although new programs are needed in several areas, details of these programs are not worked out. The following concerned areas can be mentioned:

1. Programs should be developed that will provide for greater cost-sharing to individual landowners for the installation of conservation practices that improve resources providing public benefits. Special emphasis should be given to water quality improvement. Existing programs could be modified to provide for increased cost-sharing.
2. The Resource Conservation and Development program should be expanded to cover more of the basin.
3. Programs are needed that give more attention to the environmental corridor concept and other nonstructural measures for solving resource problems. Public acquisition of areas that are unique and provide environmental benefits should be seriously considered.
4. Private land has a great potential for meeting fishing, hunting, and other recreational demands. Programs that provide incentives to open these areas to the public are needed.
5. The Minnesota Legislature created Chapter 83, Laws of 1976, which authorizes various procedures that modify the public waters and drainage laws of Minnesota. Of specific interest is the authorization of a county-by-county inventory of water basins and watercourses by the Department of Natural Resources and counties, respectively, and the creation of a State water bank program identifying eligible wetlands and specifying rights and obligations of the Commissioner of Natural Resources and the landowner.

During the interim year between introduction of the bill and its passage into law, 19 counties in the Minnesota River basin participated on a pilot basis, with the DNR, on classifying the public waters of their respective counties. To complete the watercourse inventory, each county requested help from its local SCS District Conservationist. The time spent on

the inventory was paid for by the Type IV Minnesota River Basin Study funds. The result of the effort enabled those 19 counties to test the details of the proposed law, gain cooperation with the Department of Natural Resources and offered them the opportunity to establish a county-State management inventory of the public waters in each county.

Because the bill has been signed into law, the rest of the counties in the State can begin inventory and classification procedures. The results will be county maps showing all the areas needing water permits, extended management authority over the waters in each county, and compensation for certain areas that are classified as public waters. The final step in establishing public waters is a joint State-county public hearing.

## REGIONAL AND STATE AGENCIES

The Southern Minnesota Rivers Basin Board has expressed desire for the following improvements:

1. Accelerate the application of land treatment measures to cropland, pastureland, streambank, woodland, and urban construction sites under provisions of Public Law 46.

2. Expand technical and financial assistance to help solve flooding, drainage, sediment, and erosion problems within the study area under provisions of Public Law 83-566 (such as at current construction sites in the Canby Creek Watershed).

3. Expand technical and financial assistance to help install eligible project measures to improve economic conditions of local residents within Resource Conservation and Development areas under provisions of Public Law 87-703. Examples of this assistance are installation of grade control structures, carp barriers, recreational improvements, and accelerated land treatment.

4. Provide an assortment of loans to individuals and groups for resource conservation and environmental improvements. Needed technical information relating to soil and water conservation programs and recreation needs is available through Federal Extension Service specialists.

5. Convert cropland to forest land where excessive erosion or other problems dictate change of use under provision of the cooperative State-Federal forestry programs. Also, select and implement recreational areas through use of environmental corridors and open-space areas.

6. Solve the flooding problems in the study area by installing 81 floodwater retarding structures and 10 miles of crossover levees identified in the Type IV study report under provision of Public Law 87-639.

7. Use soil survey information to determine land capability and best use through land treatment investigations and policy formulation for land use and taxing.

Other interested agencies have expressed the following needs:

1. The completion of soil surveys.
2. State cost-sharing with individuals for conservation measures.
3. Emphasis on the environmental corridor concept in development.
4. Expansion of the incentive program to open land for recreation.
5. Upstream runoff control using natural wetlands or small impoundments.
6. Minimizing effects of increased drainage in degrading water quality.
7. Comprehensive State plan for conservation of soil and water resources.
8. Education in soil and water conservation practices.
9. State land use policies and coordination between State policy and local action policy.

10. Basin-wide monitoring for water data.
11. Coordination of soil conservation legislation with 208 planning for control of nonpoint source pollution.
12. Additional information about the relationship of transportation to the overall economy and movement of goods.
13. Corrective programs to decrease roadside erosion.

## SIGNIFICANT OPPOSITION

To date, there has been no significant opposition to the desired improvements.

# PLANNING PROCESS AND PROCEDURES

## GENERAL

Formulation is used to develop a plan or plans which will provide the best uses or combination of uses of water and related land resources to meet the identified needs of the study area. However, as already noted, the problems of the many subbasins and the main stem of the Minnesota River are varied and extensive and some have been identified in previous studies. Detailed implementation solutions to all of the problems cannot be accomplished in an initial overall report. Resources, problems, and alternative plans for the overall solutions will be developed and followed by detailed implementation plans for particular subbasins or other suitable subgroupings.

The following specific planning considerations will be used in the formulation process:

a. Reduction of floodwater and sediment damage.
b. Improvement of drainage on agricultural lands.
c. Decreased erosion from proper land treatment and management.
d. Water quality management.
e. Recreation improvements.
f. Fish and wildlife habitat enhancement.

The basin-wide comprehensive water and related land resource plan was developed based on problems and needs identified by local, regional, and State organizations and local people. The Southern Minnesota Rivers Basin Commission coordinated the input and based the plan selection on alternative proposals developed by the U.S. Department of Agriculture.

The following sections establish general guidelines for conducting the multiobjective planning process in level C feasibility investigations. The guidelines are consistent with the planning requirements of the Water Resources Council Principles and Standards and related planning policies and regulations. The Principles and Standards require that Federal and federally assisted water and related land planning consider NED (national economic development) and EQ (environmental quality) as equal objectives. Four specific activities will be undertaken during the formulation process: problem identification, formulation of alternatives, impact assessment, and evaluation.

## PROBLEM IDENTIFICATION

In problem identification, the range of water and related land resource problems each study will address is determined. Planning objectives are established to give direction to subsequent planning tasks. Resource management problems and public concerns are identified and analyzed to determine the physical area to be studied; existing and projected resource conditions in the area are surveyed; and this information is synthesized into specific planning objectives. Activities to be carried out in problem identification are shown in the following table.

Summary of problem identification activities

| Activity | Summary |
|---|---|
| Determine public concerns | Identify:<br>1. Resource management issues.<br>2. Population growth.<br>3. Economic development.<br>4. Significant environmental (physical and cultural) concerns.<br>5. Others (structural vs. managerial measures, etc.) |
| Analyze resource management problems | Determine relationship between public concerns and different resource management activities.<br>No constraints on study with preestablished resource development outputs. |
| Define study area | Base definition on study authority and public concerns, resource problems, hydrologic boundaries, etc. |
| Describe base condition | Use available local, regional, and statewide data; land use plans and projections; etc.<br>Develop information on:<br>1. The resource base (economic, social, natural, archeological, historical, etc.).<br>2. The resiliency, sensitivity, and importance of ecological, cultural, and aesthetic elements of the study area.<br>3. Existing and authorized resource management systems.<br>4. Institutional base study. |
| Project future conditions | Determine range of alternative futures.<br>Consider publics' views and compromise conflicts among them.<br>Use OBERS (Office of Business, Economic Research Service) data (if not, so discuss).<br>Assess sensitivity of all projections using a supply/demand analysis as a minimum.<br>Establish "without" conditions. |
| Establish planning objectives | Determine conditions or actions needed to accomplish desired futures.<br>Screen objectives.<br>Identify objectives derived from issues, constraints, and problems.<br>Determine timing and location (when and where) of objectives.<br>Resolve conflicts or make trade-offs among objectives. |

## FORMULATION OF ALTERNATIVES

Alternatives to solve each of the problems described will be identified, evaluated, and screened in Stage II, Development of Intermediate Plans. Those alternatives remaining after the screening process will be interfaced in Stage III, Development of Final Plans, to develop a number of comprehensive implementable solutions. The selected plan will be developed from these solutions.

Types of alternatives developed in the Type IV U.S. Department of Agriculture study and their possible beneficial and adverse impacts are shown in the following tables. A map showing 206 reservoir sites evaluated in the Type IV study is on page 118. The map indicates only the physical potential for storage in the basin. More intensive investigation will be made to verify topographic and geologic data before any sites are considered for detailed planning.

Results of first iteration of preliminary plans of improvement - Type IV study

| Alternative | Impact | Evaluation | Remarks |
|---|---|---|---|
| 206 two-stage control reservoir sites on tributaries to main stem of major rivers.(1) | Decreased urban flood damages downstream of reservoir site | Beneficial | Alternative for downstream flood protection was determined economically infeasible in preliminary studies. Review of potential benefits occurring because of reduced rural and urban flood damages shows small benefits relative to reservoir costs. Detailed studies of upstream flood damage may use some upstream site locations for protection or as alternative sites for the 81 selected sites found feasible. |
| | Decreased agricultural flood damages downstream of reservoir site | Beneficial | |
| | Reduced flood insurance costs | Beneficial | |
| | Increased land use | Beneficial | |
| | Loss in wooded wetlands | Adverse | |
| | Increased fish and wildlife habitat at reservoir site | Beneficial | |
| | Permanent evacuation of personnel and property from reservoir area | Adverse | |
| | Increased water surface area (natural environment component) | Beneficial | |
| 206 peak discharge reducing reservoirs located upstream of the coteau escarpment(1) | Decreased urban flood damages downstream of reservoir site | Beneficial | This alternative would only provide protection downstream of reservoir site. Alternative would be approved by many area residents. Preliminary studies indicated that the project would be marginal; however, recreation and fish and wildlife benefits were not considered. Additional information is required to determine feasibility. Reservoirs will be considered in detailed studies. |
| | Displacement of people and property from reservoir site | Adverse | |
| | Investment, operation, and maintenance costs | Adverse | |
| | Scenic water body provided (natural environmental component) | Beneficial | |
| | Increased fish and wildlife habitat area | Beneficial | Sites were small, peak discharge reducing floodwater retarding structures. General downstream damage reduction was approximately 10 percent; would not meet sponsor's desired degree of protection. |
| | Inundation of wooded areas | Adverse | |
| | Increased land use of downstream floodplain | Beneficial | |
| | Improved water quality | Beneficial | |
| | Decreased sediment deposition in channel downstream of reservoir site | Beneficial | |
| | Loss of reservoir areas for other land use purposes | Adverse | |
| | Increased recreational opportunities | Beneficial | |
| | Increased water surface area (natural environmental component) | Beneficial | |
| 81 reservoirs located on coteau and watershed crossover levees(1) | Decreased urban flood damages below reservoir site | Beneficial | Alternatives with reservoirs and levees to confine floods were determined to be the most economically feasible. However, recreation and fish and wildlife benefits were not considered in benefit evaluation. Additional information is required to determine project feasibility. Upstream reservoirs in conjunction with crossover levees will be considered in detailed studies. |
| | Decreased agricultural flood damages below reservoir site | Beneficial | |
| | Investment, operation, and maintenance costs | Adverse | |
| | Increased fish and wildlife habitat | Beneficial | |

Results of first iteration of preliminary plans of improvement - Type IV study (cont)

| Alternative | Impact | Evaluation | Remarks |
|---|---|---|---|
| 81 reservoirs located on coteau and watershed crossover levees(1) (cont) | Inundation of wooded areas | Adverse | |
| | Increased use of downstream floodplain | Beneficial | |
| | Improved water quality | Beneficial | |
| | Decreased sediment deposition in channel downstream of reservoir site | Beneficial | |
| | Loss of reservoir area for other land use purposes | Adverse | |
| | Increased recreation opportunities | Beneficial | |
| | Increased water surface area (natural environmental component) | Beneficial | |
| 81 reservoirs and levees (10 miles) located on rivers with 2- and 10-year channel designs | Increased fish and wildlife habitat area near reservoirs | Beneficial | Alternatives with selected reservoirs and levees and varying degrees of channel improvement were determined to be favorable in preliminary studies; however, recreation and fish and wildlife benefits were not considered in benefit evaluation. Additional information is required to determine channel frequencies. Upstream reservoirs and levees in conjunction with channel improvement will be considered in detailed studies. |
| | Decreased fish and wildlife habitat along channel improvement | Adverse | |
| | Displacement of people and property from reservoir sites | Adverse | |
| | Decreased sediment deposition on downstream areas | Beneficial | |
| | Loss of wooded wetland areas | Adverse | |
| | Temporary degradation of water quality during channel improvement | Adverse | |
| | Increased land use downstream of reservoir sites | Beneficial | |
| | Increased recreational opportunities | Beneficial | |
| Crossover levees alone (10 miles) | Loss of cropland used for levees | Adverse | Alternatives were determined economically infeasible in preliminary studies. |
| | Induced peak discharge downstream | Adverse | In most areas, induced peak discharges downstream would have considerable impact on downstream areas. Not considered a viable alternative by itself. |
| | Reduced flow outside the watershed | Beneficial | |

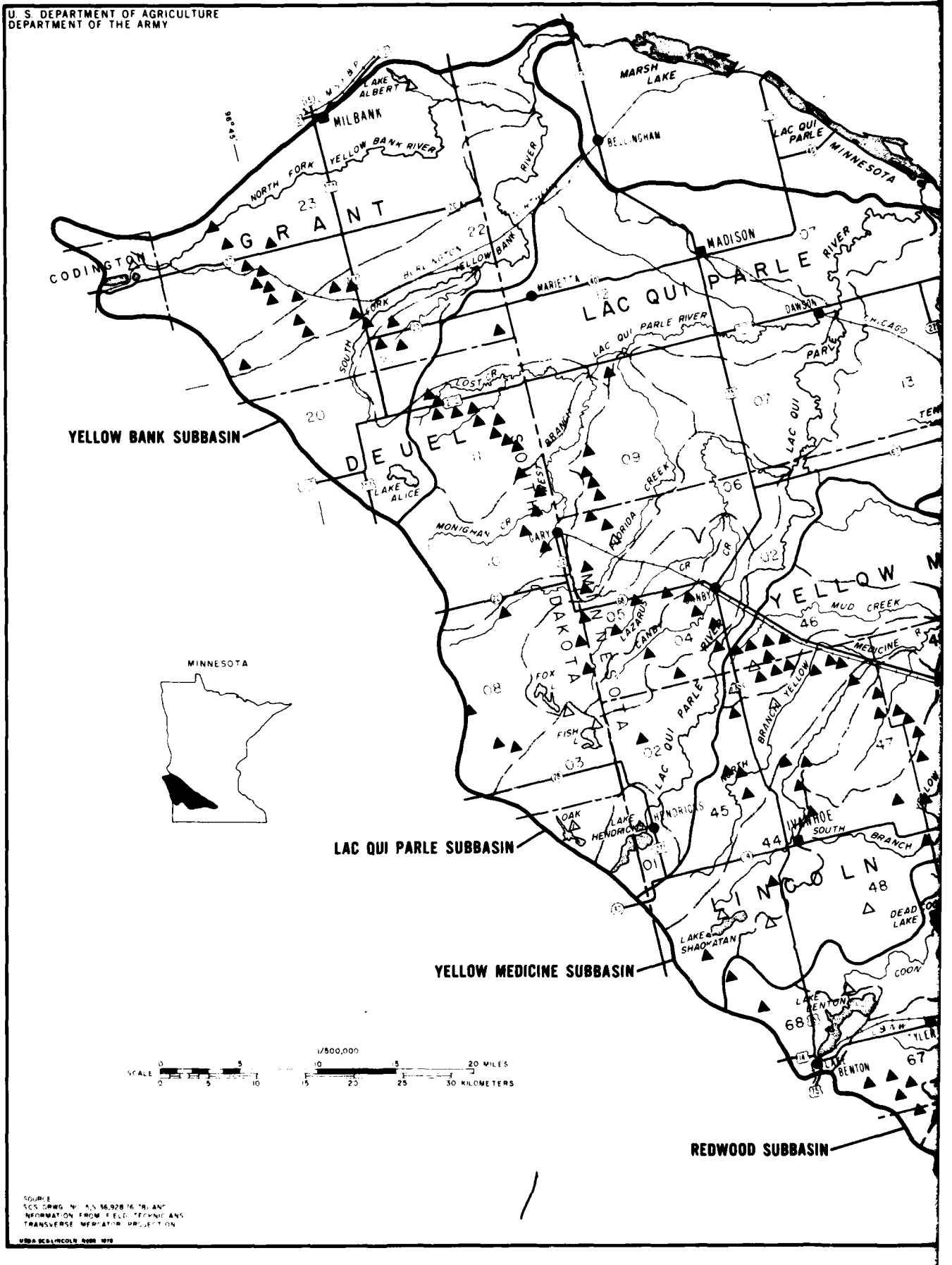
Results of first iteration of preliminary plans of improvement - Type IV study (cont)

| Alternative | Impact | Evaluation | Remarks |
|---|---|---|---|
| Channel cleanout | Decreased agricultural flood damages | Beneficial | Preliminary studies determined alternative was marginal. Additional information required. Will be considered in detailed studies (change in flow characteristics). |
| | Investment and maintenance costs | Adverse | |
| | Temporary degradation of water quality | Adverse | |
| | Loss of wooded wetlands | Adverse | |
| | Loss of fish and wildlife habitat | Adverse | |
| Channel enlargement (includes 5-year and 3-year channel designs) | Decreased urban flood damages | Beneficial | Not considered a feasible alternative by itself. Preliminary studies indicate that channel enlargement is economically feasible in some waterways. Channel enlargement would provide adequate outlet for SCS projects. Channel enlargement will be considered in detailed studies; 100-year channel enlargement will be considered in urban areas only. Lesser degrees of protection will be considered in agricultural areas but only after floodwater retarding structural program and crossover levees (alternative 3) |
| | Decreased agricultural flood damages | Beneficial | |
| | Investment and maintenance costs | Adverse | |
| | Loss of wooded wetland | Adverse | |
| | Increased land use | Beneficial | |
| | Reduced flood insurance costs | Beneficial | |
| | Temporary degradation of water quality | Adverse | |
| | Loss of fish and wildlife habitat areas | Adverse | |
| Leveed floodways (alone) (includes 10-year and 100-year leveed floodway designs) | Decreased urban flood damages | Beneficial | Preliminary studies indicate alternative not economically feasible in agricultural areas. However, detailed determinations of location benefits and inundation reduction benefits were not made. Leveed floodways were evaluated without measures to evacuate interior floodwaters. Additional information required. Detailed studies will consider leveed floodways with attendant gated outlets. Loop levees with gated outlet and/or pumping stations around small urban centers will also be considered. Levees will be considered in agricultural areas where crossover flooding occurs. |
| | Decreased agricultural flood damages | Beneficial | |
| | Investment and maintenance cost | Adverse | |
| | Loss of wooded wetland | Adverse | |
| | Increased land use | Beneficial | |
| | Loss of fish and wildlife habitat | Adverse | |
| | Temporary degradation of water quality | Adverse | |

Results of first iteration of preliminary plans of improvement - Type IV study (cont)

| Alternative | Impact | Evaluation | Remarks |
|---|---|---|---|
| Flood proofing | Decrease in flood damages to selected structures | Beneficial | Will be carried through to next iteration. Limited data preclude any reliable estimate of viability or areas with potential for flood proofing. |
| | Investment and maintenance cost | Adverse | |
| | Continuation of major portion of flood damages | Adverse | |
| | Decreased or eliminated flood insurance costs | Beneficial | |
| | Minimal impact on natural environment | Beneficial | |
| Floodplain evacuation | Disruption of agricultural life styles and attendant mental anquish | Adverse | Not economically feasible in rural or urban areas. Alternative will be considered in detailed studies in concert with structural measures to provide greenway belts and flood buffer zones. |
| | Major investment costs | Adverse | |
| | Decrease in flood damage | Beneficial | |
| | Change to less intensive use of land resource | Adverse | |
| No action | Continued flood damage | Adverse | Alternative will be carried throughout the planning process. |
| | Underuse of land resource | Adverse | |
| | Periodic evacuation of population segment | Adverse | |
| | Continued flood insurance costs | Adverse | |
| | No investment costs | Beneficial | |
| | No disruption of aquatic habitat | Beneficial | |
| | Increased wildlife area as land use becomes less intensive in flooding area | Beneficial | |

(1) See the map on page 118.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IVANHOE
SOUTH BRANCH
LINCOLN
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DEAD COON LAKE
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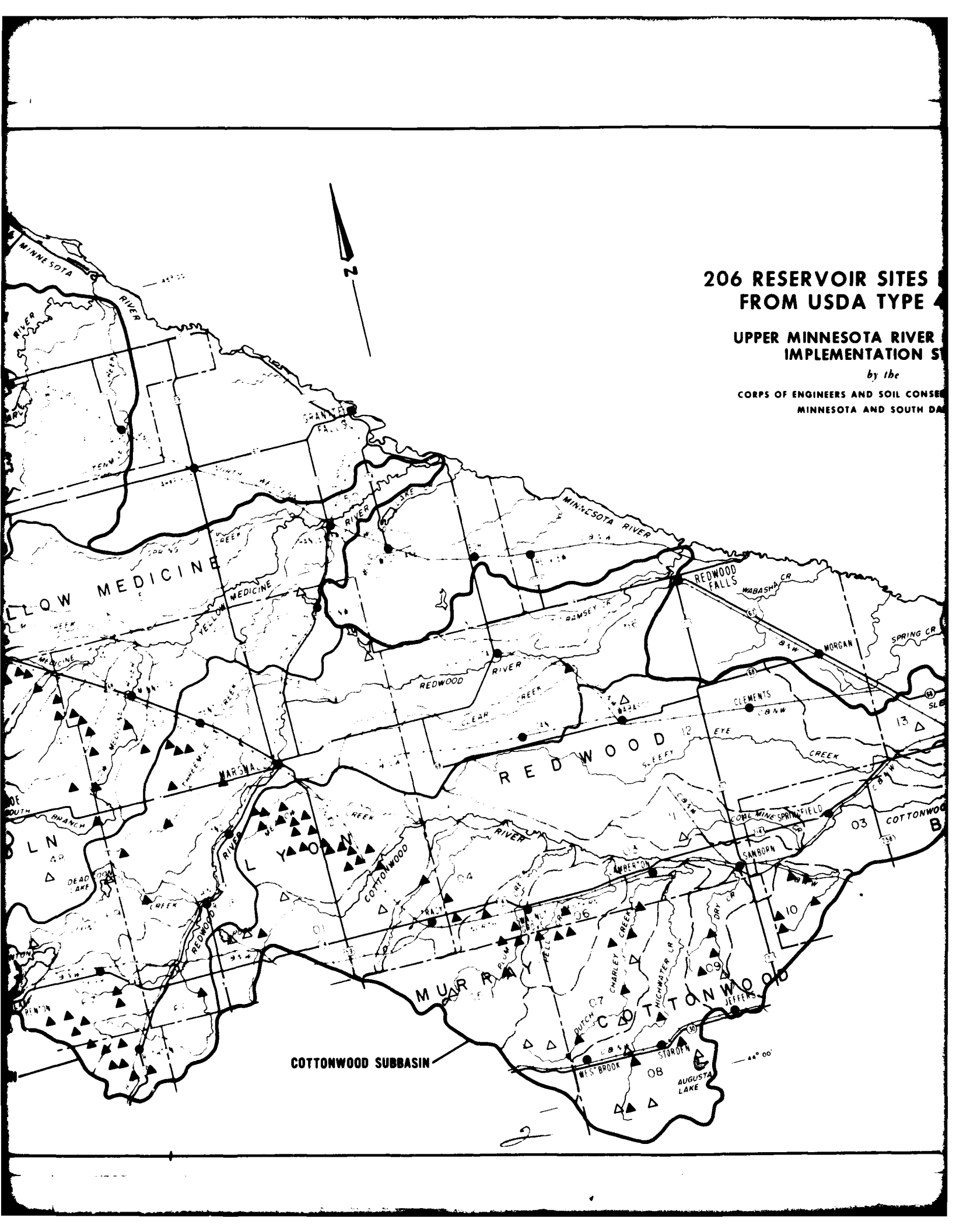
INFORMATION FROM FIELD TECHNICIANS
TRANSVERSE MERCATOR PROJECTION




# 206 RESERVOIR SITES
# FROM USDA TYPE

## UPPER MINNESOTA RIVER
## IMPLEMENTATION S

*by the*

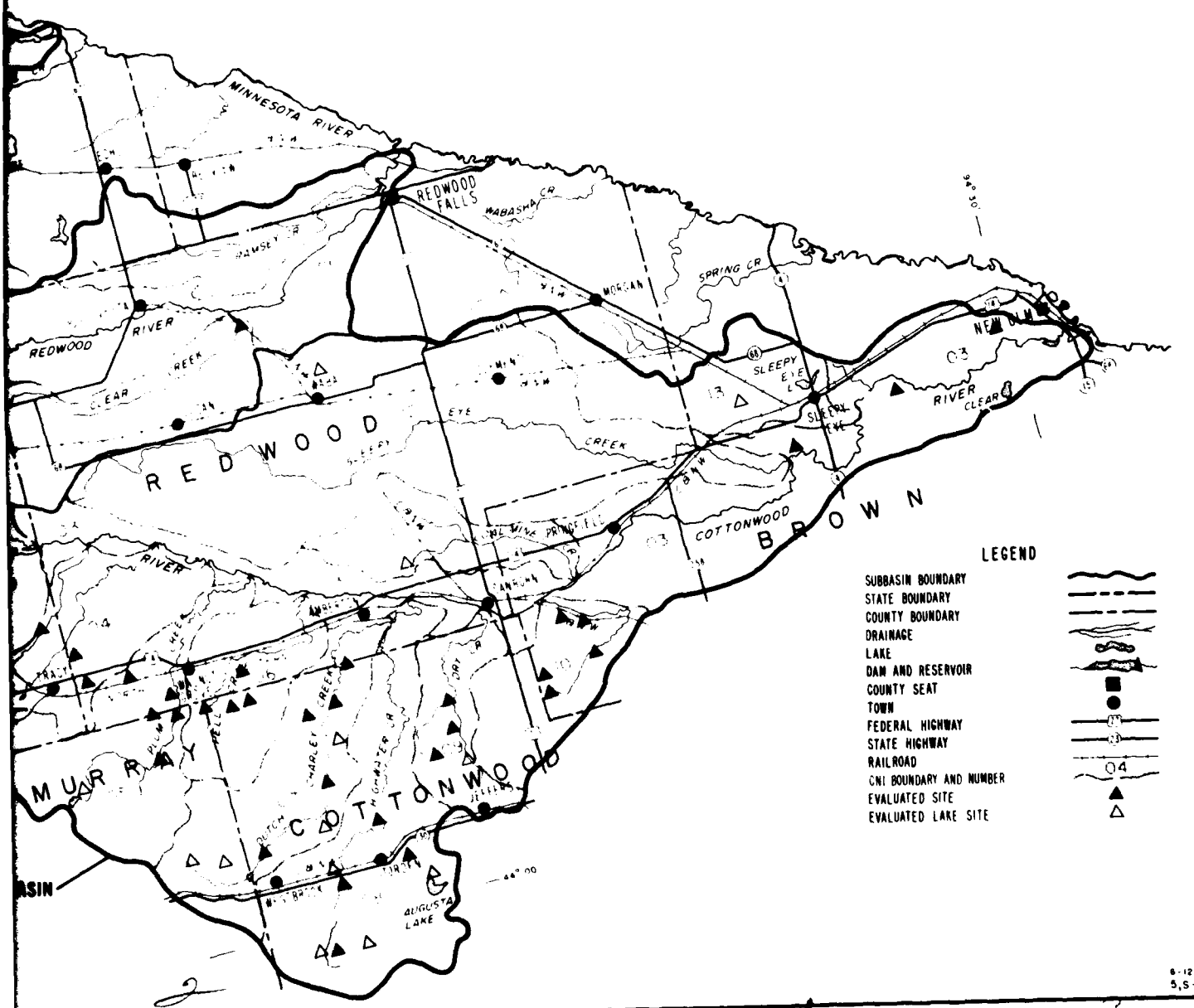
CORPS OF ENGINEERS AND SOIL CONSE
MINNESOTA AND SOUTH DA

# 206 RESERVOIR SITES EVALUATED FROM USDA TYPE 4 STUDY

## UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY

*by the*

CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE
MINNESOTA AND SOUTH DAKOTA

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The plans which are initially formulated will be assessed and evaluated. Plans which best address NED, EQ, and a mix of the two will be identified. Candidates for NED plans are those which are likely to maximize net economic benefits; candidates for EQ plans are those that make the most significant contributions to preserving, maintaining, restoring, or enhancing cultural and natural resources. During subsequent iterations, candidate plans will be reformulated to insure that the best NED, EQ, and mix plans are included in the final array of alternatives. Designation and reformulation of candidate plans require substantial professional analysis and judgment and should reflect public preferences and desires. If appropriate, the plans should meet the 1983 water quality goals of Public Law 92-500 which represent the minimum environmental standards consistent with national policy. The NED and EQ plans are not intended to establish a polar condition. Because a plan that optimizes NED and one that emphasizes EQ must still meet a range of specific evaluation criteria, they could be similar or even the same plan. Where NED and EQ plans are significantly different, other alternatives reflecting significant trade-offs between them will be formulated so as not to overlook the best overall plan. An essentially "nonstructural plan" and a "no development plan" will be carried through the planning process. Activities to be carried out in formulation of alternatives are shown in the following table.

Summary of plan formulation activities

| Activity | Summary |
|---|---|
| Identify management measures | Consider technical vs. institutional means and constraints.<br>Nonstructural means should be considered equally. |
| Categorize applicable nonstructural and structural measures | Examine conflicts among measures and complementariness of measures.<br>Examine contributions to many objectives versus one objective.<br>Prepare statement of findings. |
| Develop plans | Synthesize measures into plans.<br>Select measures and determine how well they meet the identified objectives.<br>Identify conflicts and those objectives not met.<br>Analyze remaining objectives as a basis for identifying structural measures that address a number of objectives.<br>Add structural measures that address single objectives to complete the system.<br>Develop the NED and EQ plans.<br>Consider possible no development alternatives:<br>a. Maintain current land use.<br>b. Maintain bridge capacities and road network. |
| Consider plans of others | Consider plans of Federal, State, and local governments and private organizations. |

## IMPACT ASSESSMENT

Impact assessment is the identification, description, and, if possible, measurement of the effects of the different alternative plans on the base year condition. Consistent with the requirements of the Principles and Standards, Section 102(2)(c) of the National Environmental Policy Act, Council on Environmental Quality Guidelines and Section 122 of the River and Harbor Act of 1970, impact assessment

provides for analyzing the significant effects of each alternative. These effects are the economic, social, historical, archeological, or environmental consequences of an alternative that would likely have a material bearing on the decision-making process. Impact assessment requires forecasting where and when significant primary and higher order effects could result from implementing a given alternative. This determination requires analyzing and displaying monetary and nonmonetary changes in an objective manner based on professional and technical assessment of the resources. The absence of change or no net change from the base condition could also be a significant impact in certain instances and care must be taken to develop such information during this task. Describing impacts does not reflect societal preferences; these preferences are determined through subsequent evaluation. Activities to be carried out in impact assessment are shown in the following table.

Summary of impact assessment activities

| Activity | Summary |
|---|---|
| Identify source of impacts | Categorize whether impact is by the measure itself, its inputs (natural resources, energy, labor, etc.), or its outputs (plan products). |
| Identify and trace impacts | Perform cause-effect analysis. |
| Determine incidence of impacts. | Identify:<br>1. Location - study area, OBERS area(s), and/or the Nation.<br>2. Timing - prior to, during, or after plan implementation or in long-term future.<br>3. Duration - short- or long-term.<br>4. Reversibility. |
| Measure impacts | Determine changes from the base condition. |

## EVALUATION

Evaluation is the analysis of each plan's impacts compared with the "without condition" and other plans. Whereas impacts are identified through an objective undertaking largely on professional analysis, evaluation determines the subjective value of these changes. This determination is accomplished by conducting "with" and "without" analyses of the alternative plans. The process begins by establishing the contributions of each alternative to the planning objectives and the NED, EQ, regional development, and social well-being accounts of the Principles and Standards. The response of the alternatives to specified evaluation criteria will be determined. From this information, judgments will be made concerning the beneficial and adverse nature of the contributions of an alternative to establish its overall desirability. The first three activities listed below provide more explicit information on performing this aspect of evaluation. The relative merits of each remaining alternative in comparison with the other remaining alternatives will then be established. By so doing, evaluation will reveal information which will be incorporated in succeeding iterations to achieve more fully beneficial contributions while reducing adverse contributions. Activities to be carried out in evaluation are shown in the following table.

Summary of evaluation activities

| Activity | Summary |
|---|---|
| Categorize impacts | Compare impacts with planning objectives to identify any relationships.<br>Identify actual or potential beneficial or adverse contributions:<br>1. Actual - will occur under the auspices of a governmental agency or the normal working of the economic system.<br>2. Potential - requires action by a different agency or entity.<br>Determine contributions to national accounts:<br>1. Identify and note uncertainties.<br>2. Note who or what gains or loses.<br>3. Identify location, time, and duration.<br>4. Identify unintended contributions, reformulate if significantly adverse. |
| Identify NED and EQ plans | System of accounts. |
| Determine national interest | 1. Total economic and environmental benefits of plans.<br>2. Total economic and environmental costs of plans.<br>3. Compare benefits and costs. |
| Apply other specified evaluation criteria | Acceptability by affected publics.<br>Certainty that planning objectives are met.<br>Completeness - whether all actions needed for full attainment have been incorporated.<br>Effectiveness - technical performance and contribution to objectives.<br>Efficiency - least cost performance.<br>Equity - fair distribution of advantages and disadvantages by family income classes.<br>Benefit-cost ratio.<br>Planning space - relevancy of geographic area encompassed by plan.<br>Reversibility - is return to base condition possible if unusual future conditions so warrant?<br>Stability - what range of alternative futures can be accommodated? |

Summary of evaluation activities (cont)

| Activity | Summary |
|---|---|
| Perform trade-off analysis | Compare monetary and nonmonetary units, data, and qualitative information.<br>Trade-offs must reflect public preferences, State and national interests and constraints. |
| Specify basis for next iteration | Base on trade-off analysis.<br>Increase beneficial and reduce adverse contributions.<br>Maximize actual contributions and reduce uncertainty.<br>Identify mitigation measures for unavoidable adverse impacts.<br>Consider mitigation based on Federal initiative. |

## REPORT DEVELOPMENT

### GENERAL

The interim feasibility investigations and the overall basin study will be conducted in three stages.

### STAGE I - DEVELOPMENT OF A PLAN OF STUDY

During this stage, principal emphasis will be on the identification of resource management problems and concerns in the study area. Because of the introductory nature of the planning process in this stage, the effort will generally involve analyzing a wide range of available data that may be more qualitative than quantitative. The general purpose of this stage is to make an initial analysis of water and related land resource management problems and how they may be solved. The product will be plan of study (POS) document describing the scope of the interim study and the broad management actions necessary to carry it out.

## STAGE II - PREPARATION OF A PRELIMINARY FEASIBILITY REPORT

The preliminary feasibility investigation will be an assessment of water and related land resource problems, needs, concerns, and potential solutions identified in the plan of study. The preliminary feasibility report will formulate an array of alternative plans, identify impacts, and determine the advisability of proceeding with more detailed studies. The report will be based on review and evaluation of available data and limited field and office studies. All studies and data requirements for more detailed investigations will be identified during this stage. Problems and needs to be investigated in a preliminary manner during this stage of study include flooding, inadequate drainage of cropland, erosion and sedimentaion, and water quality. The investigation will consider beneficial and adverse impacts of alternatives on recreation, fish and wildlife, and other environmental features peculiar to the subbasins.

## STAGE III - FEASIBILITY REPORT

The feasibility report will analyze differences among alternatives and the corresponding effects of trade-offs between the national economic development and environmental quality objectives. Major study efforts will involve collection and evaluation of required data, a system of accounts display, and formulation of the optimum scale of development.

If feasible solutions for problems of the subbasins as well as the overall basin are identified in the preliminary feasibility studies, the feasibility report will specifically identify the measures which appear to best solve the problems. Recommendations will be made in the report that these measures be included as part of the selected subbasin plan. The draft feasibility report and draft environmental impact statement will be coordinated with agencies and other publics. Authorization, advance planning, and funding by Congress are necessary before any of the measures recommended in the feasibility report can be developed.

## INSTITUTIONAL ANALYSIS

An institutional analysis identifies institutions directly or indirectly related to water resources planning and management. Their potential role in the planning process or capability to implement alternatives is assessed.

Many Federal, State, and local agencies and other groups were contacted during the Type IV study by the SCS. The specific roles and responsibilities of each of these agencies were not clearly defined, nor is it certain that all parties affected by the study were identified. An institutional analysis to resolve this uncertainty and better define institutional coordination will be undertaken during stage II of this study. The agencies and groups listed in the following table participated in collection and assembly of data for the Type IV report.

Agencies or groups participating in data collection, Type IV study

| Level | Agency or group |
|---|---|
| Federal | U.S. Department of Agriculture |
| | Soil Conservation Service |
| | Economic Research Service |
| | Agricultural Extension Service |
| | Forest Service |
| | Farmers Home Administration |
| | Agricultural Stabilization and Conservation Service |
| | U.S. Department of the Interior |
| | Heritage Conservation and Recreation Service |
| | Fish and Wildlife Service |
| | Geological Survey |
| | U.S. Department of Defense |
| | Corps of Engineers |
| State | Minnesota Water Planning Board |
| | Departments of Natural Resources - South Dakota, Iowa, and Minnesota |
| | Minnesota Pollution Control Agency |
| | Minnesota Department of Economic Development |
| | Minnesota State Planning Agency |
| | Minnesota Historical Society |
| | Minnesota Soil and Water Conservation Board |
| Local | Soil and Water Conservation Districts |
| | University of Minnesota |
| | County government officials |
| | Local residents and citizens committee |
| | Water Resources Board |

The Corps of Engineers and Fish and Wildlife Service have a coordination agreement which applies to this study. Regional representatives of the Fish and Wildlife Service have been asked to participate in the study and furnish data and assistance as appropriate during the study. The service's planning aid letter concerning fish and wildlife resources in the study area is in appendix B. During Stages II and III, the Fish and Wildlife Service will:

1. Analyze study alternatives and proposals affecting fish and wildlife resources.
2. Determine the probable effects of potential projects on fish and wildlife resources and associated habitats.
3. Recommend measures to prevent or reduce damages to and improve conditions for fish and wildlife.
4. Participate in public meetings and workshops.

## STUDY MANAGEMENT

### INTRODUCTION

Management procedures have been defined which will serve as a guide for conducting the study. The Department of Agriculture and Corps of Engineers will coordinate all planning activities under the direction of the Minnesota State Conservationist (Soil Conservation Service) and the District Engineer (St. Paul District, U.S. Army Corps of Engineers). Day-to-day responsibility for the study rests with the Staff Leader, River Basin and Watershed Planning Section (Soil Conservation Service, U.S. Department of Agriculture) and the Chief, General Investigations Section, Planning Branch (St. Paul District).

### DIVISION OF STUDY RESPONSIBILITY

Study management was defined during preparation of the plan of study. The investigation is managed by cochairpersons from the SCS and Corps. Work groups composed of technical representatives from both agencies and other Federal and State agencies handle the technical study efforts. The following table illustrates how work group leadership and support functions are divided between the SCS and Corps.

Division of study responsibility

| Work group | Lead agency | Support agency |
|---|---|---|
| Public Involvement | SCS/Corps | - |
| Planning and Study Management[1] | SCS/Corps | - |
| Hydrology and Hydraulics | SCS | Corps |
| Engineering[2] | Corps | SCS |
| Erosion and Sedimentation | SCS | Corps |
| Economics | SCS | Corps |
| Environmental[3] | SCS | Corps |
| Water Quality | Corps | SCS |

(1) Includes the study cochairpersons and all other work group chairpersons.

(2) Includes geology and foundations investigations, embankment-levee design, other design, real estate, and cost estimates.

(3) Includes biological resources, cultural resources, recreation resources, and social analysis subgroups.

The study cochairpersons, in consultation with discipline supervisors from the lead agencies, assigned these leadership and support responsibilities. The assignments were reviewed by the study advisory committee. Previous study area involvement (for example, SCS hydrology work for the Type IV study) and recognized scope of expertise (for example, Corps large dam design and dam safety program) helped determine the initial assignment of responsibility. Some modifications to the division of responsibility could be made as a result of funding levels, directives from higher authorities, or changes in study objectives agreed to by all study participants.

## SOUTHERN MINNESOTA RIVERS BASIN BOARD (SMRBB)

The purpose and intent of this board as stated in Minnesota Statutes, Chapter 114A, are as follows:

"114A.03 Purpose and Intent. Subdivision 1. The southern Minnesota rivers basin board is hereby established to serve as the regional organization for guiding the creation and implementation of a comprehensive environmental conservation and development plan for the basin. All state departments and agencies are hereby directed to cooperate with the board, and to assist it in the performance of its duties. In cooperation with all federal agencies, including but not limited to the United States departments of agriculture and interior and the corps of engineers, all state agencies, departments, and commissions, including but not limited to the department of natural resources, Minnesota geological survey, water resources board, state planning agency, department of transportation, soil and water conservation board, pollution control agency, department of economic development, department of agriculture and the institute of agriculture of the University of Minnesota, and local governments and citizens within the basin, the board shall initiate, coordinate and prepare its overall comprehensive environmental conservation and development plan. The Minnesota soil and water conservation board and local soil and water conservation districts and watershed districts within the basin shall provide technical assistance to the board in the creation and implementation of the plan. Upon the request of the board, the governor or the legislature may require any other department or agency of the state to furnish assistance, technical or otherwise, to the board in the performance of its duties or in the exercise of its powers authorized by law. The plan may include, but is not limited to, planning for the following purposes:

(1) Control or alleviation of damages by flood waters;

(2) Improvement of stream channels for handling of surface waters, navigation, and any other public purposes;

(3) Reclaiming or filling of wet and overflowed lands;

(4) Regulating the flow of streams and conserving the waters thereof;

(5) Diverting or changing watercourses in whole or in part;

(6) Providing and maintaining water quality and supply for municipal, domestic, industrial, recreational, agricultural, aesthetic, wildlife, fishery, or other public use;

(7) Providing for sanitation and public health and regulating uses of streams, ditches, or watercourses for the purpose of disposing of waste and maintaining water quality;

(8) Repair, improvement, relocation, modification, consolidation, or abandonment in whole or in part of previously established public drainage systems within the territory;

(9) Imposition of prevention or remedial measures for the control or alleviation of land and soil erosion and siltation of watercourses, or bodies of water affected thereby;

(10) Regulation of improvements and land development by abutting landowners of the beds, banks, and shores of lakes, streams, watercourses and marshes by permit or otherwise in order to preserve the same for beneficial use; such regulation to be in accordance with state department of natural resource standards and criteria;

(11) Regulation of construction of improvements on and prevention of encroachments in the flood plains of the rivers, and the lakes, marshes and streams of the basin; such regulation to be in accordance with state department of natural resources standards and criteria.

Subd. 2. Implementation of plan. Upon reviewing and approving the overall comprehensive environmental conservation and development plan for the basin, the board shall be the coordinating agency for the implementation of the plan and it may designate and request any local unit of government, including but not limited to counties, cities, soil and

water conservation districts and watershed districts, to initiate, implement and carry out any phase, project or improvement provided for in the board's plan. The board may engage in public education programs."

The Southern Minnesota Rivers Basin Board will continue to work toward implementation of flood control measures in the study area according to recommendations in the Type IV study. It established an advisory committee with the following policy-level representation:

Mr. Arnold Onstad, Chairperson, Southern Minnesota Rivers Basin Board

Mr. George Bekeris, Area Manager, Fish and Wildlife Service

Colonel Forrest T. Gay, III, District Engineer, St. Paul District, Corps of Engineers

Mr. Tom Kalitowski, Chairperson, Minnesota Water Planning Board

Mr. Harry Major, Scate Conservationist, SCS

Mr. Willard Pearson, Chairperson, Area II Action Committee

## ADVISORY COMMITTEE

The advisory committee facilitates communication and transfer of information to the agencies and persons interested in the study. It insures that various concerns of the study are given an open forum for expression and establishes work groups comprising technical representatives from Federal and State agencies, assesses work products, and provides support or redirection.

The committee is an innovative approach that assures that interested agencies and groups will be continuously informed during planning. In this way, they can guide the process.

## CITIZENS ADVISORY COMMITTEES

Two citizens committees have been formed. The Policy Committee was established by the Southern Minnesota Rivers Basin Board to provide local input and guidance for investigations in the study area. It has broad membership in the area.

The Action Committee, recently incorporated as the Area II Minnesota River Basin Projects Incorporated, has five voting members - one from each subbasin in the study area. This committee is a citizens advisory committee for a 10-county area with emphasis on implementation of recommendations of the Type IV study. South Dakota has one nonvoting member. Efforts are being made to upgrade this to full voting representation.

## COORDINATION AND STUDY MONITORING

The principal study coordinator and monitor is the advisory committee. This function is performed through interaction with SCS and the Corps as investigators, the Southern Minnesota Rivers Basin Board as overall coordinator of the Minnesota River basin studies, and the Area II Action Committee as the principal local group at the present time in the public involvement program. This function will expand as the study progresses. The need for detailed information on economic, environmental, and social impacts of alternative plans will continue to include more local individuals and interest groups in the planning process. Letters documenting interagency coordination, interest, and concerns are included in appendix A.

# PUBLIC INVOLVEMENT PROGRAM

## GENERAL

Although the Soil Conservation Service and Corps of Engineers share responsibility for the study, close liaison will be maintained with Federal, State, and local agencies and local interests to insure development of a complete and factual study.

## OBJECTIVES

Public participation in study planning provides timely information and assurance that alternatives will, to the extent possible, be responsive to public needs and preferences. The Federal participants will evaluate the engineering aspects and weigh the environmental, economic, and social impacts of the alternatives. The public will participate in establishing criteria to screen values among alternatives. Elected officials retain the major decision-making authority in the trade-off analysis in the selection of a plan.

## IDENTIFICATION OF PUBLICS

The publics are individuals, agencies, and other groups that may be decision-makers or those to whom the people look for guidance in the solving of problems. These representatives balance the needs and preferences of constituents and other technical and political groups which influence plan selection.

## AGENCY AND GROUP RESPONSIBILITIES

A public involvement program helps to bring out all issues concerning a particular study and insures that these issues are given full consideration. To a large extent, this purpose can be accomplished by directing public involvement efforts to a limited, organized segment of the public - interest groups, relevant government agencies and officials at all levels, key citizens (sometimes referred to community influentials), and individual citizens who would experience significant impacts from any of the alternatives considered. Initially, this group is likely to be small, because only a limited number of people are interested in relatively general discussions of planning objectives, problems, and potential solutions. As alternatives become better defined and their impacts known, more people will become interested because they can see how they will be affected. The key is to identify these groups and individuals early in the study so that they can be involved from the start.

One of the best means for providing public involvement is through a citizens participation committee composed of a uniform cross section of individuals from the study area representing civic and conservation groups; residential, business, commercial, and other interests from the urban community; agricultural interests; members of the academic community; members of professional groups; and representatives of the various political subdivisions involved (cities, townships, and counties). A manageable committee would be composed of about 10 to 15 members.

The Corps of Engineers, SCS, and other interested Federal and State interests would serve as technical advisors to the committee. Involvement of the SCS field staff (area and district conservationists) will be extremely important.

The functions of the committee are to:

1. Provide valuable assistance in keeping the public fully informed about study status and progress.
2. Solicit from all concerned interests their opinions and views regarding possible solutions.
3. Provide a definite contribution in assessing impacts on the existing resources, evaluating all alternatives and selecting the best plan.
4. Hold meetings open to the public and disseminate pertinent information discussed at the meetings through the news media.
5. Adopt a position paper summarizing its activities and covering any proposals they agree should be taken into account in the decision-making and subsequent planning phases.

This committee could be formed by the Southern Minnesota Rivers Basin Board. The Area II Policy Committee served in a similar manner during the Type IV Study. The committee functions as explained above would be advisory but also decision-making in being a forum for expression of both proponent and opponent concerns of area interest groups, weighing the concerns and other facts, and recommending action to best meet the needs of the publics.

To complement the public involvement centered at the local level will be a defined institutional arrangement for decision-making and advice from the regional, State, and Federal level to the Governors of Minnesota and South Dakota. The regional level could be represented by the Southern Minnesota Rivers Basin Board and the East South Dakota Conservancy District. The coordination assignment at all levels would be specific in distinguishing between decision-makers in public involvement and the ongoing technical input from the State, regional, and Federal agencies during the study.

## MEETINGS

The citizens participation committee meetings are open to the public. The meeting formats may be workshop oriented particularly when requesting views on criteria for forming and screening alternatives. The committee will host and arrange for meetings as needed to keep represented bodies and groups informed on study alternatives and status and to give input to the study; for example, suggestions on additional alternatives for the study. Sufficient notice of the meetings will give all interest groups the opportunity to be a part of the planning process.

Specific meetings will be scheduled to correspond with the need to review study products as described below.

1. A meeting will be held to review the plan of study and establish criteria to make value judgments among alternatives.
2. At the completion of preliminary feasibility studies when alternative solutions are known but before a plan has been tentatively selected, a midstudy public meeting will be held. Major purposes of this meeting are to present the results of preliminary studies including the advantages and disadvantages of the various alternatives to the extent that such information has been developed and to further develop public views and desires, particularly as they relate to the various alternatives.
3. A late stage public meeting will be held after detailed studies and before report completion. Findings of the detailed studies, including the rationale for any proposed solution, and the tentative recommendations will be presented. This meeting will insure that any plan presented would be acceptable.

The approximate calendar schedule for the public meetings is shown on the sequence diagram (see page 174). Notices for the public meetings will be distributed to interested Federal, State, regional, and local agencies, institutions and groups about 1 month before each meeting.

ACTIVITIES

The initial coordination meeting for the joint study effort took place in July 1975 at St. Paul. The meeting was attended by representatives from the SCS, Minnesota Department of Natural Resources, Area II Action Committee, and Corps of Engineers. Representatives from the congressional delegations also attended the meeting. Discussion centered on the complex flooding problems in the study area and resulted in a recommendation by the participants to request authorization for a joint SCS-Corps implementation study under Public Law 87-639. The study was authorized by the Committee on Public Works and Transportation of the House of Representatives in December 1975.

Following the initial meeting and the subsequent study authorization, a number of coordination meetings were held during 1976 and 1977. The SCS and Corps were funded to begin the study in October 1977 (fiscal year 1978).

The Southern Minnesota Rivers Basin Board recognized that the study and any subsequent implementation would be successful if the Federal, State, and local agencies and the concerned citizens cooperated and agreed on the course of the study. For this reason, the board formed an advisory committee for the study with the following membership: Area II Action Committee, Minnesota Water Planning Board, SCS, Corps, and Fish and Wildlife Service. It will be chaired by the Southern Minnesota Rivers Basin Board. The first meeting of the advisory committee was held on 9 December 1977. The second meeting of the advisory committee was held 7 April 1978. The preliminary draft plan of study was presented and distributed for review and comment.

A bus tour of the study area was conducted by local sponsors on 25 through 27 April 1978. Representatives of local, State, and Federal agencies from Minnesota and South Dakota were invited.

A joint SCS-Corps meeting with the South Dakota Natural Resources Subcabinet took place on 3 May 1978 at Pierre, South Dakota. An orientation presentation was made by the study cochairperson. A presentation on the study was made to a joint Minnesota-South Dakota SCS Area Conservationist's meeting 23 May 1978.

Soil Conservation Service Washington office and Technical Service Center personnel met with study participants to review overall study direction and the preliminary draft plan of study on 30 May-2 June 1978. A joint meeting was held with personnel from the Corps St. Paul and North Central Division offices on 1 June 1978.

The third meeting of the advisory committee was held on 9 June 1978. Comments received on the preliminary draft plan of study were reviewed.

The advisory committee conducted a public orientation meeting at the Ramada Inn at Marshall on 26 July 1978. A second tour of the study area sponsored by the advisory committee and assisted by local sponsors was conducted on 27 July 1978.

This draft plan of study will be coordinated with local, State, and Federal agencies during October 1978.

## DETAILED STUDIES, WORK SCHEDULE AND COST

### STUDIES REQUIRED

#### General

Water and related land resource problems, needs, and potential solutions have been identified in this plan of study. Various types of studies will be undertaken to assure continual accuracy and completeness of investigations. The total study effort is divided into eight major work groups - public involvement; planning and study management; hydrology and hydraulics; engineering; erosion and sedimentation; economics; environmental; and water quality. A description of work to be done and a listing of the major work items, time sequence, products, and personnel requirements are shown for each work group.

#### Plan Selection and Formulation

A final water and land resources management plan will be selected and the optimum scale of project development will be formulated based on four factors: national economic efficiency, environmental quality, regional development, and social well-being. The factors are referenced in Federal Register, Volume 38, No. 174, Part III, 10 September 1973, which gave notice of Principles and Standards for planning water and related land resources effective 25 October 1973.

#### Planning and Study Management

Planning studies will assess the flood and related water and land resource problems of the study area. Alternative solutions will be investigated for solving these problems. Current formulation criteria and policies will be used to evaluate the development of alternative plans

incorporating both nonstructural and structural measures as appropriate. Analysis of alternatives and impacts of trade-offs among national economic development, environmental quality, and social well-being will be assessed in selection of the best solution. The major study effort will be to select a final plan that best meets overall area resource needs and formulate the optimum scale of project development. As an integral part of the planning effort, coordination will be maintained with the interested publics throughout all stages of the study. Report preparation and development will be a specific responsibility of this work group. The study will be conducted in accordance with all applicable legislation, rules and regulations, guidelines, and executive orders for land and water resource planning.

Study management will involve managing the overall study effort to insure the conduct and timely completion of the study. The following are management tasks:

1. Monitor study progress to insure adherence to the schedule.
2. Program funds needed to accomplish the study and monitor the spending of funds.
3. Make arrangements for administrative support.
4. Select and negotiate with consultants for technical assistance to be accomplished under contract.
5. Coordinate with other Federal, State, and local offices.
6. Review all study products to insure their quality and conformance with criteria and guidance set forth by regulations.
7. Prepare correspondence and routine documents.
8. Prepare interim and final reports and appendixes.

The following table presents a schedule of planning and study management tasks.

Planning and study management schedule

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Man-days by agency and discipline: Corps of Engineers — Study co-chairperson | Planning engineer | Draftsman | Writer-editor | Typist | Reporting | Soil Conservation Service — Study co-chairperson | Assistant coordinator | Engineering aid draftsman | Typist | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Stage I: Plan of Study** | | | | | | | | | | | | | | | |
| 200 | Coordination meeting before authorization attended by representatives from the SCS, Corps, State of Minnesota, and congressional delegations. | | Jul 75 | | Recommendation by participants to request joint SCS-Corps Implementation Study | | | | | | | | | | | |
| 201 | Study authorization by Congress | | Dec 75 | | | | | | | | | | | | | |
| 202 | Begin study | SCS/Corps | Oct 77 | | | | | | | | | | | | | |
| 203 | Orientation sessions for planning participants | | Nov 77 | May 78 | | | | | | | | | | | | |
| 204 | Establish Study Advisory Committee | SCS/Corps | Sep 77 | Dec 77 | Initial meeting of committee | | | | | | | | | | | |
| 205 | Preliminary identification of problems and generalized alternatives | Minnesota | Oct 77 | Jul 78 | | | | | | | | | | | | |
| 206 | Establish study criteria, procedures, and outline for plan of study | SCS/Corps | Oct 77 | May 78 | Preliminary draft plan of study | 55 | 10 | 10 | 10 | 10 | 10 | 55 | 40 | 5 | 5 | 210 |
| 207 | Tour of study area by local, State, and Federal agencies | SCS/Corps | Apr 78 | Apr 78 | Orientation | | | | | | | | | | | |
| 208 | Public meeting and tour of study area sponsored by Study Advisory Committee | | Jul 78 | Jul 78 | Public involvement | | | | | | | | | | | |
| 209 | Review and coordination of draft plan of study | SCS/Corps | Jun 78 | Jul 78 | Draft plan of study | | | | | | | | | | | |
| 210 | Submit plan of study to higher authorities | SCS/Corps | Sep 78 | Sep 78 | Draft plan of study | 55 | | 10 | 10 | 10 | 10 | 55 | 20 | 5 | 5 | 180 |
| | **Stage II: Development of Preliminary Alternatives** | | | | | | | | | | | | | | | |
| 211 | Facilitate studies and inventories of work groups | SCS/Corps | Oct 78 | Mar 79 | Display of problems and needs | 45 | | | | | | 35 | 10 | | | 90 |
| 212 | Conduct local public participation workshop to verify problems and needs and identify criteria for screening alternatives | | Apr 79 | Apr 79 | Public involvement and valid set of problems and needs | 65 | | 20 | 5 | 10 | | 60 | 5 | 10 | 10 | 185 |
| 213 | Formulate components of alternatives under:<br>1. Present conditions (no action plan)<br>2. Future without project conditions<br>3. Nonstructural project such as environmental corridors and/or changed land use<br>4. With structural project such as reservoirs, levees, floodways, and/or channel modifications | | Oct 78 | Aug 79 | | 110 | 165 | | | | | 95 | 150 | | | 520 |

Planning and study management schedule (Cont)

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Man-days by agency and discipline: Corps of Engineers — Study co-chairperson | Planning engineer | Draftsman | Writer-editor | Typist | Report processing | Soil Conservation Service — Study co-chairperson | Assistant coordinator | Engineering aid draftsman | Typist | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage II: Development of Preliminary Alternatives (cont) | | | | | | | | | | | | | | | |
| 214 | Preliminary plan formulation<br>1. NED components<br>2. EQ components<br>3. Mixed NED/EQ components<br>4. Display alternatives including costs and impacts | | Oct 79 | Mar 80 | | 110 | 83 | 5 | 3 | 5 | | 96 | 83 | 5 | 10 | 400 |
| 215 | Preliminary evaluation of alternatives<br>1. Impacts on planning objectives<br>2. Apply specific evaluation criteria such as acceptability, completeness, effectiveness and efficiency<br>3. Draft systems of accounts | | Apr 80 | Sep 80 | | 92 | 69 | 5 | 3 | 5 | | 80 | 69 | 5 | 10 | 338 |
| 216 | Plan formulation public meeting | | Nov 80 | Nov 80 | | 18 | 14 | | | | | 16 | 14 | | | 62 |
| 217 | Preliminary report and environmental assessment submitted to higher authority | | Oct 80 | Dec 80 | | 36 | 27 | 20 | 20 | 20 | 20 | 32 | 27 | 10 | 10 | 222 |
| 218 | Review and coordinate preliminary report and environmental assessment | | Jan 81 | Jan 81 | | 18 | 14 | | | | | 16 | 14 | | | 62 |
| 219 | Checkpoint conference with higher authority and approval of memo for record | | Feb 81 | Feb 81 | | 18 | 14 | | | | | 16 | 14 | | | 62 |
| | Stage III: Development of Detailed Alternatives | | | | | | | | | | | | | | | |
| 220 | Final definition of problems and needs | | Mar 81 | Mar 81 | | 18 | 14 | | | | | 16 | 14 | | | 62 |
| 221 | Final formulation of alternatives | | Apr 81 | Sep 81 | | 110 | 83 | 5 | 3 | 5 | | 96 | 83 | 5 | 10 | 400 |
| 222 | Trade-off analysis of alternatives and final system of accounts | | Oct 81 | Nov 81 | | 36 | 27 | | | | | 32 | 27 | | | 122 |
| 223 | Designate NED and EQ plans | | Dec 81 | Jan 82 | | 36 | 27 | 4 | 3 | 4 | | 32 | 27 | 4 | 8 | 145 |
| 224 | Identify selected plan | | Feb 82 | May 82 | | 72 | 54 | | | | | 64 | 54 | | | 244 |
| 225 | Draft report and EIS submission to higher authorities | | Jun 82 | Sep 82 | | 72 | 54 | 20 | 20 | 20 | | 64 | 54 | 10 | 10 | 324 |
| 226 | Checkpoint conference with higher authority and approval of memo for record | | Oct 82 | Oct 82 | | 18 | 14 | | | | | 16 | 14 | | | 62 |
| 227 | Coordinate draft report and EIS | | Nov 82 | Dec 82 | | 36 | 27 | 4 | 3 | 4 | | 32 | 27 | 4 | 8 | 145 |
| 228 | Public meeting | | Jan 83 | Jan 83 | | 18 | 13 | | | | | 16 | 14 | | | 61 |
| 229 | Final report and revised draft EIS submitted to higher authorities | | Jan 83 | Apr 83 | | 72 | 54 | 10 | 10 | 10 | | 64 | 54 | 5 | 5 | 284 |
| | Total | | | | | 1,110 | 763 | 113 | 90 | 103 | 40 | 988 | 814 | 68 | 91 | 4,180 |

19 man years

## Hydrology and Hydraulics

Hydrology and hydraulic studies will be performed to further define the problems and needs in the subbasins. Studies of the existing problems and needs will involve a quantitative analysis of:

1. Area flooded for a range of flood frequencies.
2. Roads and bridges subject to flood damage.
3. Areas subject to streambank erosion and floodplain scour.
4. Flow characteristics of streams including peak flows by frequency, water yield, and flow duration data.

Hydrology and hydraulic studies will also provide primary data for the formulation of structural and nonstructural alternatives and evaluation of their impacts. These studies will include:

1. An inventory of potential reservoir sites including the proportioning of dam embankments and spillways that are found to be physically feasible.
2. An inventory of stream reaches where channel capacity is limited and channel improvement and/or levees may be feasible including the preliminary hydraulic design of possible channel modifications and/or levees in these reaches.
3. An analysis of the water yield and flow characteristics of streams to evaluate the potential for recreation and fish and wildlife enhancement at potential reservoir sites.
4. A display of the extent of nonstructural alternatives such as environmental corridors and/or other changed land use plans.
5. An evaluation of the physical impact of alternatives on area flooded, roads and bridges, floodplain scour areas, and the flow characteristics of streams.

Specific hydrologic and hydraulic studies to assist in defining the problems in the subbasins and provide data for plan formulation and the analysis of plan impacts are listed below. The product resulting from these studies and an indication of the magnitude of each study is also included.

1. A study to delineate area flooded for any given frequency of flood in the major damage areas including crossover flow areas. Delineation will be made for existing conditions for structural and nonstructural alternatives. The delineations will be made initially on 500-foot per inch topographic maps with the capability of display at other scales and on photomosaics. Floodplain delineation will encompass an area of 450-550 square miles.

2. A study to determine the elevation-discharge-area flooded and discharge-frequency in each major damage reach for existing conditions and for alternatives. Studies will include determination of the frequency at which damages begin in each reach. Elevation-discharge-area flooded values will be provided in tabular form for 250-300 reaches. Water surface profile drawings will be made for selected flood frequencies.

3. The hydrologic and hydraulic design of structural works including dam spillways and outlet works, channel and levee works, and all appurtenant structures such as culverts, bridges, and grade mobilization structures. Operation plans will be developed for dams with gated spillways. Hydraulic designs will be performed for 70-90 dams, 200-300 miles of channel work, 10-30 miles of levees, and numerous appurtenant structures.

4. A determination of channel and floodplain velocities including a display of reaches that may be subject to streambank erosion and floodplain scour.

5. A determination of water yield and flow characteristics of streams. Statistical analyses will be made for 20-25 stream gages. Water budget studies will be performed to evaluate water-based recreation potential in 10-20 reservoirs.

Following is a description of the methods to be used in carrying out the studies. A hydrologic computer model will be developed using established modeling techniques of the Corps and SCS. The model will be capable of developing synthesized runoff hydrographs and combining and routing hydrographs through the reservoirs and stream reaches of the subbasins, including the capability of dividing hydrographs at locations of crossover flow between watersheds and subbasins. The model will be capable of predicting discharge-frequency at any desired point in the subbasins for present conditions and for any alternative. The model

will be tested and verified by comparing derived hydrographs with observed hydrographs at existing recording stream gages in the watershed and by comparing derived peak discharges with statistical analysis of all stream gage data in the region. The statistical analyses will be carried out according to U.S. Water Resources Council Bulletin 17A, "Guidelines for Determining Flood Flow Frequency."

The Corps HEC-1, HEC-5, and SSARR and SCS TR-20 hydrologic models will be considered for use. The five subbasin area of 4,353 square miles will be divided into 800-1,000 subwatersheds to develop hydrographs and flood routing.

A water surface profile computer model will be developed for the five rivers and all tributary reaches expected to benefit from alternatives. The profiles will be developed for a range of flood frequencies for existing and alternative conditions. Existing condition profiles will be calibrated from available historical flood high-water marks and profiles. The profile model will establish:

1. Elevation-discharge-end area values for use in flood routing.
2. Elevation-discharge-area flooded values for use in the tabulation and delineation of flooded area.
3. Channel and floodplain velocities for use in flood routing and for determining reaches subject to streambank erosion and areas of floodplain scour.
4. Existing bank-full capacities for use in establishing structure release rates and reservoir operation.
5. Tail water elevations for design of structure outlet works.
6. Channel dimensions and levee heights for alternatives.

The Corps HEC-2 or the SCS WSP-2 water surface profile model will be used. The water surface profile model will involve an estimated 1,200-1,400 miles of floodplain, 6,000-7,000 valley cross sections, and 800-1,000 bridges and culverts. Valley cross-section coordinates will be developed by scaling from 200-foot per inch topographic maps with a basic contour interval of 4 feet and 2-foot interpolated contours and spot elevations in flat areas. Channel cross sections and bridge and culvert data will be obtained by field surveys.

The hydrologic and hydraulic design of floodwater retarding structures will be accomplished using the SCS DAMS-2 computer program and applicable Corps programs. All designs will meet the appropriate safety standards according to the hazard classification of the structure.

The design discharge for channels, levees, and appurtenances will be based on the hydrologic model. Hydraulic design will be accomplished using the water surface profile computer program.

The following table presents a schedule of hydrology and hydraulics studies.

Schedule of hydrology and hydraulics studies

| Code | Work item | Responsible agency | Responsible discipline | Starting date | Completion date | Product | Man days by agency and discipline: Corps of Engineers — Hydraulic engineer | Corps of Engineers — Engineering technician | Corps of Engineers — Hydrologist | Soil Conservation Service — Hydraulic engineer | Soil Conservation Service — Engineering technician | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Stage II: Inventory Existing Problems and Needs** | | | | | | | | | | | |
| | **Evaluate Potential Flood Damages** | | | | | | | | | | | |
| 300 | Review existing data, finalize procedures, establish survey and topographic mapping needs | SCS/Corps | Hydrology/ Hydraulics | Oct 78 | Dec 78 | Final detailed plan of study for Hydrology and Hydraulics Work Group | 20 | | 10 | 30 | | 60 |
| 301 | Prepare and execute contract for channel and bridge surveys | SCS/Corps | Hydraulics | Oct 78 | May 80 | Completed surveys | 60 | 20 | | 30 | | 110 |
| 302 | Prepare and execute contract for topographic maps of floodplains | SCS | Hydrology | Oct 78 | May 80 | Topographic maps with 4-foot contours, 2-foot interpolations, and spot elevations in flat areas on 1 inch = 200 feet pencil manuscripts | | | | 30 | 30 | 60 |
| 303 | Prepare working maps for determining watershed boundaries, determine watershed size, damage reaches, etc., for hydrologic model | SCS | Hydrology | Oct 78 | Jan 79 | Four sets of 7 1/2-minute U.S. Geological Survey maps | | | | 5 | 30 | 35 |
| 304 | Determine runoff curve numbers or loss rates | SCS/Corps | Hydrology | Dec 78 | May 79 | Tabulations and maps | | | 20 | 15 | 25 | 60 |
| 305 | Determine times of concentration and reach routing coefficients in upland watersheds | SCS/Corps | Hydrology | Dec 78 | May 79 | Tabulations | | | 60 | 70 | | 130 |
| 306 | Establish runoff versus frequency versus drainage area, make VDP studies and rainfall-runoff analysis | SCS/Corps | Hydrology | May 79 | Jul 79 | Tabulations and graphs | | | 40 | 40 | | 80 |
| 307 | Establish and run water surface profile model for range of discharges, establish rating curves for crossover flow points, establish routing coefficients for major floodplains | SCS/Corps | Hydraulics | Jan 79 | Apr 80 | Tabulations and computer print-out | 200 | 400 | | 400 | 400 | 1,400 |
| 308 | Run hydrologic model, calibrate and finalize model | SCS/Corps | Hydrology | May 79 | Apr 80 | Schematic drawing of routing order and computer print-out with range of discharge versus frequency | | 50 | 150 | 80 | | 280 |
| 309 | Run water surface profiles for a range of flood frequencies, check results | SCS/Corps | Hydrology | Apr 80 | Jun 80 | Schematic layout of WSP's and computer print-out of elevation versus discharge versus area flooded | 40 | | | 80 | | 120 |
| 310 | Prepare area flooded and flow frequency data for determination of area flooded by frequency | SCS/Corps | Hydrology | Apr 80 | Jul 80 | Tabulations of discharge versus frequency and elevation versus discharge versus area flooded | 20 | | 20 | 60 | | 100 |
| 311 | Delineate existing condition area flooded versus frequency for visual display | SCS | Hydrology | Jul 80 | Oct 80 | Delineate area flooded on 1 inch = 500 feet topographic maps | | | | 10 | 80 | 90 |
| 312 | Establish elevation versus discharge data for roads and bridges (input to determine bridge damage); preliminary (not refined with frequency) | SCS/Corps | Hydrology | Jan 79 | Jun 80 | Tabulations | 10 | 10 | | 10 | 60 | 90 |
| 313 | Develop data to determine areas of streambank erosion and floodplain scour | SCS/Corps | Hydraulics | Jan 79 | Jun 80 | Tabulations, maps, profiles | 20 | 20 | | 40 | 40 | 120 |
| 314 | Establish seasonal distribution of floods | SCS | Hydrology | Aug 79 | Dec 79 | Tabulation of percent chance that a flood will occur in a given month of any year | | | | 20 | | 20 |
| 315 | Complete all data for economic analyses of existing flood damages | SCS | Hydrology | Dec 78 | Jul 80 | Tabulated data | | | | 40 | 20 | 60 |

Schedule of hydrology and hydraulics studies (cont)

| Code | Work item | Responsible agency | Responsible discipline | Starting date | Completion date | Product | Man days by agency and discipline: Corps of Engineers — Hydraulic engineer | Engineering technician | Hydrologist | Soil Conservation Service — Hydraulic engineer | Engineering technician | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stage II: Formulate Alternatives | | | | | | | | | | | |
| | Prepare Data for Structural Alternatives | | | | | | | | | | | |
| 316 | Inventory and evaluate the physical potential for reservoir storage (inventory sites, determine storage potential) | SCS Corps | Hydraulics Hydraulics | Oct 78 Aug 79 | Oct 79 May 80 | 7 1/2-minute maps of sites, elevation versus surface area and elevation storage curves | | 120 | 40 | 40 | 80 | 280 |
| 317 | Establish hazard class and hydrologic criteria for design of selected sites (Tc and hydrologic criteria for PSH, ESH, and FBH) | SCS Corps | Hydrology Hydrology | Oct 78 May 79 | Aug 79 Aug 79 | Tabulations | | | 60 | 20 | | 80 |
| 318 | Hydraulic design of spillways for dams | SCS Corps | Hydraulics Hydraulics | Oct 78 May 80 | Jan 80 Aug 80 | Elevations-discharge-storage data from SCS DAMS 2 program or Corps hydraulics programs | | | 150 | 200 | 200 | 550 |
| 319 | Locate reaches with limited channel capacity | SCS/Corps | Hydraulics | Jan 79 | Aug 80 | Tabulations, maps, profiles | 10 | 20 | | 20 | | 50 |
| 320 | Hydraulic design of channels and/or levees | SCS/Corps | Hydraulics | Jan 80 | Oct 80 | Plan view alignment, WSP print-out and drawings | 500 | 500 | | 120 | 80 | 1,200 |
| 321 | Evaluate potential for recreation and fish and wildlife enhancement at potential reservoir sites (water budget studies, flow characteristics of streams) | SCS/Corps | Hydrology | Oct 78 | May 80 | Computer print-out, graphs, and drawings | | | 40 | 50 | 50 | 140 |
| | Evaluate Nonstructural Alternatives | | | | | | | | | | | |
| 322 | Evaluate and display nonstructural alternatives | SCS | Hydrology | Jan 80 | Aug 80 | Delineation on maps or mosaics | 30 | 20 | 30 | 40 | 80 | 200 |
| | Evaluation and Display of Alternatives | | | | | | | | | | | |
| 323 | Summarize hydrologic and hydraulics data for all alternatives, display results | SCS/Corps | | Jan 80 | Aug 80 | Tabulations, maps, drawings | 20 | | 20 | 40 | 40 | 120 |
| | Stage II: Prepare Preliminary Report and Environmental Assessment | | | | | | | | | | | |
| | Prepare Hydrology and Hydraulics Section | | | | | | | | | | | |
| 324 | Write narrative report; prepare tables, graphs, etc., for report | SCS/Corps | Hydrology/ Hydraulics | Aug 80 | Oct 80 | Preliminary report and environmental assessment | 10 | | 10 | 60 | 10 | 90 |
| | *Stage III: Complete Investigations, Refine Analyses of Alternatives, Prepare Final Report* | | | | | | | | | | | |
| | Finalize Evaluation of Existing Flood Damages | | | | | | | | | | | |
| 325 | Refine, verify, and run final hydrologic and hydraulic models for existing conditions | SCS/Corps | Hydrology/ Hydraulics | Oct 80 | May 81 | Computer print-out | 30 | | 30 | 40 | 20 | 120 |
| 326 | Prepare final data for economic analyses of existing flood damages | SCS | Hydrology/ Hydraulics | May 81 | Aug 81 | Tabulations | 10 | | 10 | 20 | 20 | 60 |
| | Finalize Design of Structural Plans and Evaluation of Nonstructural Alternatives | | | | | | | | | | | |
| 327 | Refine and verify hydraulic design of dam spillways | SCS/Corps | Hydraulics | Oct 80 | Apr 82 | Computer print-out, drawings | 100 | 100 | | 50 | 50 | 300 |
| 328 | Refine and verify hydraulic design of channels and levees for alternatives | SCS/Corps | Hydraulics | Oct 80 | Apr 82 | Computer print-out, plan view drawings, and WSP's | 300 | 200 | | 50 | 50 | 600 |
| 329 | Refine data for evaluating nonstructural alternatives | SCS/Corps | Hydrology/ Hydraulics | Oct 80 | Apr 82 | Maps, tabulations | 20 | | 20 | 30 | 30 | 10 |
| 330 | Prepare data for economic analyses and environmental impact of alternatives | SCS/Corps | Hydrology/ Hydraulics | Nov 81 | Jun 82 | Tabulations | 30 | 30 | 30 | 50 | 50 | 190 |
| | *Identify and Evaluate Selected Plan, Prepare Input to Final Report and EIS* | | | | | | | | | | | |
| 331 | Identify and finalize evaluation of selected plan | SCS/Corps | Hydrology/ Hydraulics | Jun 82 | Aug 82 | Data for economic and environmental evaluation of the selected plan | 20 | | 10 | 20 | | 50 |
| 332 | Prepare hydrology and hydraulics inputs to final report and EIS | SCS/Corps | Hydrology/ Hydraulics | Aug 82 | Oct 82 | Final report and EIS | 20 | | 10 | 20 | | 50 |
| | Total | | | | | | 1,470 | 1,490 | 760 | 1,830 | 1,445 | 6,995 |
| | | | | | | | | | | | | 31.8 man years |

## Engineering

The types of engineering studies that will be performed include geology, foundations, embankment-levee design, other design and cost estimates, and real estate. All of the studies undertaken will be accomplished using appropriate engineering standards, regulations, and guidelines.

Foundations. - The geotechnical investigation will be done in enough detail to permit selection of the most favorable project sites, determine the general type of structure best suited to the site conditions, and ascertain the costs of development.

The foundation investigation work will include a thorough search of existing soils and geology data; field mapping of exposed cuts, outcrops, and channel banks; a reconnaissance trip to establish site selection and alignment; the taking of soil and rock borings; laboratory testing of representative samples to establish design parameters; and investigation of borrow sources for major construction materials. These investigations will be of sufficient scope to support the proposed design, cost estimates, conclusions, and recommendations that relate to soils and geology.

Channel design would include riprap if necessary. Final design of the riprap would determine gradation, thickness, size and extent, and other erosion or scour preventive features. These designs would conform to current methods and criteria.

Reservoir and levee embankments would be designed to be safe against overtopping from the design flood and under extremes of operation. Embankments would not be designed to impose excessive stresses on foundation materials. They would have slopes that are stable under all conditions of impoundment operations. Seepage through their foundations and abutments would be controlled as necessary. Final design would conform to current design criteria.

All pertinent foundation, geologic, and survey information will be summarized in the final report. Detailed supporting data will appear in an appendix.

Layout, Structural Design, and Cost Estimates. - Embankments would be laid out on detailed topographic maps and typical sections would be prepared. Embankment quantities would then be computed. Outlet works would be laid out in plan sections. Preliminary structural designs would be undertaken as needed. They would be in accordance with appropriate criteria and guidelines. Structural quantities would be computed. Charts, illustrations, and plates would be prepared in accordance with drafting standards. Right-of-way requirements would be determined from layout of structures and embankments.

First costs for design features, including appropriate allowances for advance engineering, design, and contingencies, would be estimated in detail. Estimates of first costs would reflect prevailing price levels for similar work in the area. Annual costs, including appropriate allowances for operation, maintenance, and scheduled replacement of major project features, would be estimated based on the current interest rate.

The cost estimate and construction schedule for the selected plan will be summarized in the final report. Detailed supporting data will appear in an appendix.

Real Estate. - Real estate studies will be conducted using accepted policies and guidelines. Right-of-way and land ownership requirements in the floodplain would reflect costs of permanent and temporary easements, acquisition costs, relocation costs, land required for recreation and mitigation, severance payments, and other damages. These studies would be accomplished only in enough detail to indicate a gross appraisal.

The following table presents a summary of required engineering studies.

Schedule of engineering studies

Man Days by agency and discipline

Soil Conservation Service

Soil

Corps of Engineers

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Geologist GS-11 | Geologist GS-5 | Drill logger | Drill operator WAE | Mechanical engineer | Civil engineer | Technician | Geologist | Engineer | Technician | Draftsman | Supervisory | Secretary | Survey crew | Boring crew |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 401 | Review existing material for field reconnaissance | SCS | Oct 78 | Sep 79 | Preliminary data | 67 | 67 | | | | 81 | | | | | | | | | |
| 402 | Field reconnaissance | SCS/ Corps | Oct 78 | Sep 79 | Reconnaissance report | 34 | 34 | | | 34 | 41 | | 14 | 14 | | | | | | |
| 403 | Determine hazard classification | SCS | Oct 78 | Sep 79 | Design criteria | | | | | | 40 | | | | | | | | | |
| 404 | Lay out soil borings | SCS/ Corps | Nov 78 | Oct 79 | Field location for boring crew | 34 | | | | | | | | 14 | 7 | | 7 | | | |
| 405 | Determine uses to be investigated | SCS/ Corps | Nov 78 | Oct 79 | Design alternatives | | | | | | 41 | | | 7 | | | | | | |
| 406 | Obtain soil borings | SCS/ Corps | Dec 78 | Dec 81 | Boring logs and material for testing | 67 | | 201 | 201 | 201 | 34 | | | 28 | | | 7 | | | 98 |
| 407 | Establish $\frac{C}{L}$ | SCS/ Corps | Nov 78 | Dec 79 | Define most suitable location | | | | | | 81 | | | 14 | 7 | | 7 | | | |
| 408 | Lab testing (3) | SCS/ Corps | Dec 78 | Dec 81 | Define soil parameters for design | 34 | | | 124 | 124 | | | | 21 | | | | | | |
| 409 | Layout surveys | SCS/ Corps | Dec 78 | Dec 79 | Field location for survey crew | | | | | | 81 | | | | 14 | | | | | |
| 410 | Tie in soil borings | SCS/ Corps | Dec 78 | Dec 81 | Location of soil borings | | | | | | 40 | 81 | | 7 | 7 | | | | 7 | |
| 411 | Survey | SCS/ Corps | Jan 79 | Jan 80 | Survey notes | | | | | | 81 | 162 | | 7 | 7 | | | | 35 | |
| 412 | Plot soil borings | SCS/ Corps | Jan 79 | Dec 81 | Profile of soil conditions at site | | | 111 | | | | | | 7 | 28 | | | | | |
| 413 | Analyze soil test results | SCS/ Corps | Feb 79 | Dec 81 | Define characteristics of material | 67 | | | | | | | | 35 | | | 28 | | | |
| 414 | Reduce and plot survey marks | SCS/ Corps | Feb 79 | Feb 80 | Map of existing site conditions | | | | | | | 81 | | | 56 | | | | | |
| 415 | Prepare soils map - site and drainage area | SCS | Mar 79 | Dec 81 | Soil map by site | 67 | 67 | 13 | | | | | | | | | | | | |
| 416 | Determine sediment storage requirements | SCS | Mar 79 | Dec 81 | Design requirements | 67 | 67 | | | | | | | | | | | | | |
| 417 | Determine floodplain damages - scour and gully | SCS | Mar 79 | Dec 81 | Table of damages | 34 | 34 | | | | | | | | | | | | | |
| 418 | Stability, seepage, and settlement | SCS/ Corps | Mar 79 | Mar 80 | Critical conditions controlling design | | | | | 67 | | | | 140 | 14 | | 56 | | | |
| 419 | Design | SCS/ Corps | Apr 79 | Mar 80 | Drawing ($\frac{C}{L}$ typical section profile) | | | | | 34 | | | 14 | 140 | 28 | | 56 | | | |
| 420 | Phase II layout | SCS/ Corps | May 79 | Apr 80 | Drawing (plan) | | | | | | 81 | 81 | | 28 | 28 | 49 | | | | |
| 421 | Coordinate Phase II layout | SCS/ Corps | May 79 | Apr 80 | Proper layout of geotechnical features | 34 | | | | | 41 | | | 28 | 14 | | 7 | | | |
| 422 | Earthwork quantities | SCS/ Corps | May 79 | May 80 | Table | | | | | | 81 | 81 | | 14 | 21 | | | | | |
| 423 | Structure design | SCS/ Corps | May 79 | May 80 | Phase II drawings | | | | | | 81 | 81 | | 14 | | | | | | |
| 424 | Coordinate structural design and estimating | SCS/ Corps | May 79 | May 80 | Compatibility of features | 33 | | | | | 40 | | | 14 | 14 | | | 14 | | |
| 425 | Structure quantities | SCS/ Corps | Jun 79 | May 80 | Table | | | | | | 81 | 81 | | 14 | 7 | | | | | |
| 426 | Cost estimate | SCS/ Corps | Jul 79 | May 80 | Table | | | | | | 81 | 162 | | 70 | | | | | | |
| 427 | Review cost estimate | SCS/ Corps | Aug 79 | May 80 | Confirm cost | | | | | | 81 | | | 14 | | | | | | |
| 428 | Phase II plates | SCS/ Corps | Sep 79 | May 80 | Input to Phase II report | 34 | | | | | 40 | 162 | 14 | 56 | 56 | | 7 | 14 | | |
| 429 | Phase II report write-up | SCS/ Corps | Oct 79 | May 80 | Phase II report | 9 | | | | 30 | 183 | 324 | 14 | 133 | 28 | 49 | 7 | 14 | | |

Schedule of engineering studies (Cont)

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Man-days by agency and discipline: Soil Conservation Service — Geologist GS-11 | Geologist GS-5 | Drill logger | Drill operator | WAE | Soil mechanics engineer | Civil engineer | Technician | Corps of Engineers — Geologist | Engineer | Technician | Draftsman | Supervisory | Secretary | Survey crew(1) | Boring crew(2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 430 | Review Phase II report | SCS/ Corps | Jun 80 | Sep 80 | Selected plan for Phase III | 10 | | | | | 10 | 40 | | 7 | 14 | | | 7 | 14 | | |
| 431 | Determine detailed mapping requirements | SCS/ Corps | Aug 80 | Oct 80 | Detailed topographic site map | | | | | | | 20 | | | 14 | | | | | | |
| 432 | Reevaluate Phase II results | SCS/ Corps | Oct 80 | Sep 81 | Determine needs for Stage III | | | | | | | 122 | | 7 | 7 | | | 7 | 14 | | |
| 433 | Revise structure C, L if required | SCS/ Corps | Nov 80 | Oct 81 | Confirm/revise location | | | | | | | 41 | | | 7 | | | | | | |
| 434 | Lay out additional soil borings | SCS/ Corps | Nov 80 | Oct 81 | Field location of additional borings | | | | | | | | | | 14 | 7 | | 7 | | | |
| 435 | Lay out additional surveys | SCS/ Corps | Nov 80 | Oct 81 | Field location of additional surveys | | | | | | | 40 | | | | 7 | | | | | |
| 436 | Obtain soil borings | SCS/ Corps | Nov 80 | Dec 81 | Boring logs and material for testing | | | | | | | | | | 14 | | | 7 | | | 42 |
| 437 | Tie in additional soil borings | SCS/ Corps | Dec 80 | Jan 82 | Location of soil borings | | | | | | | | | | | 7 | | | | 7 | |
| 438 | Plot soil borings | SCS/ Corps | Jan 81 | Feb 82 | Profile of soil conditions at site | | | | | | | | | | 14 | | | | | | |
| 439 | Soil lab testing(4) | SCS/ Corps | Jan 81 | Feb 82 | Define critical soil parameters for design | | | | | | | | | | 14 | | | | | | |
| 440 | Obtain additional surveys | SCS/ Corps | Jan 81 | Feb 82 | Survey notes | | | | | | | 121 | 243 | | | 7 | | | | 21 | |
| 441 | Analyze soil borings and test results | SCS/ Corps | Feb 81 | Mar 82 | Refine characteristics of soil | | | | | | | | | | 14 | | | 7 | | | |
| 442 | Reduce and plot surveys | SCS/ Corps | Feb 81 | Mar 82 | Map of existing site conditions | | | | | | | | 81 | | | 28 | | | | | |
| 443 | Reanalyze and refine design | SCS/ Corps | Mar 81 | Mar 82 | Improved design | | | | | | 20 | 243 | 162 | | 56 | 28 | | 7 | | | |
| 444 | Finalize layout | SCS/ Corps | Apr 81 | Mar 82 | Drawing (plan, profile, section) | | | | | | | 81 | 162 | | 56 | 56 | 98 | | | | |
| 445 | Review final layout | SCS/ Corps | May 81 | Apr 82 | Approve geotechnical features | | | | | | 10 | 40 | | 14 | 70 | 14 | | 7 | | | |
| 446 | Finalize earthwork quantities | SCS/ Corps | May 81 | Apr 82 | Table | | | | | | | 81 | 81 | | 28 | 42 | | | | | |
| 447 | Finalize structure quantities | SCS/ Corps | May 81 | Apr 82 | Table | | | | | | | 81 | 81 | | 56 | 14 | | | | | |
| 448 | Finalize cost estimate | SCS/ Corps | Jun 81 | Apr 82 | Table | | | | | | | 81 | 162 | | 140 | | | | | | |
| 449 | Review cost estimate | SCS/ Corps | Jul 81 | Apr 82 | Confirm cost | | | | | | | 81 | | | 14 | | | 7 | | | |
| 450 | Prepare report plates | SCS/ Corps | Oct 81 | May 82 | Report plates (main report and appendixes | | | | | | | | 81 | 14 | 84 | 126 | | 7 | | | |
| 451 | Prepare report write-up | SCS/ Corps | Oct 81 | May 82 | Appendixes and portions of main report | | | | | | 20 | 123 | 162 | 14 | 210 | 14 | 98 | 7 | 28 | | |
| 452 | Review final report | SCS/ Corps | Jun 82 | Sep 82 | Final input | | | | | | 10 | 40 | | | 14 | 14 | | 14 | 14 | | |
| | Total | | | | | 672 | 269 | 325 | 325 | 325 | 269 | 2,511 | 2,511 | 112 | 1,659 | 700 | 294 | 266 | 112 | 70(1) | 140(2) |

(1) Crew days - three-man crew.
(2) Crew days - four-man crew.
(3) Does not include Lincoln SCS lab cost. No time estimate available for Corps lab.
(4) No time estimate available for Corps lab.

Erosion and Sedimentation

Studies will be undertaken to evaluate sedimentation and erosion concerns in the study area. The Minnesota SCS State resource conservationist will head up the work group. The work group will consist of representatives from soil and water conservation districts, the SCS area conservationists, and others as needed.

Available data from sources such as the Conservation Needs Inventory, Type IV river basin report, 208 Non-Point Sources of Pollution Inventory, and Resource Conservation Act will be used to the maximum extent possible.

Major work items include inventorying existing land use, determining level of land treatment applied, locating critical sediment producing areas, developing alternative land treatment programs, integrating resource data into other work groups, and contributing to the formulation and evaluation planning process.

Protection and management measures, including all types of conservation treatment and practices, are a basic need in the conservation, development, and use of land and water resources. The following factors will be evaluated to determine the need or lack of need for accelerated application of land treatment in the study area:

1. The extent and location of critically eroding areas.

2. The extent and location of land needing treatment and the type of practices that, to an important degree, will reduce erosion and sediment, control runoff, conserve water, enhance fish and wildlife habitat, or improve water quality.

3. The acreage of land adequately protected and the kind and extent of land treatment now on the land that is meeting conservation needs.

4. The number and location of active cooperators and acres they control.

5. The number, acreage, and location of conservation plans where land treatment is already applied or in the process of being applied.

6. The extent and location of adequate soil surveys and other inventory data.

7. The ability of other ongoing programs to satisfy land treatment needs during the project installation period.

8. The extent to which local sponsors and landowners are willing to commit their resources to installing land treatment.

9. Work load estimates for additional soil surveys and planning, application, and maintenance of land treatment to meet land treatment goals during the project installation period.

10. Operations schedule, developed in keeping with other multi-year plans, for meeting land treatment goals.

11. Estimates of the cost of technical and financial assistance for planning, application, and maintenance of land treatment in the plan.

SCS policy in Minnesota requires that 50 percent of the land area upstream from a potential SCS reservoir site be adequately protected before the reservoir is built. Policy in South Dakota requires a higher level of protection. While SCS policy is not a constraint for possible Corps reservoirs, the Corps supports the concept that land treatment should be applied to the extent practicable with emphasis on critical areas that contribute sediment to any proposed structures or contribute to solving identified NED or EQ needs.

The following table is a schedule of Erosion and Sedimentation Work Group activities.

Schedule of erosion and sedimentation studies

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Man-days by agency and discipline: State resource conservationist | Soil conservationist | Area conservationists | District conservationists | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 510 | Inventory present status (land treatment, erosion hazard) | SCS | Oct 78 | Sep 79 | Inventory | 15 | 42 | 15 | 110 | 182 |
| 520 | Preliminary report and environmental assessment inputs | SCS | Sep 79 | Sep 80 | | 15 | 42 | 15 | 140 | 212 |
| 530 | Develop alternatives for land treatment | SCS | Sep 80 | Oct 81 | Proposed alternatives | 15 | 42 | 15 | 103 | 175 |
| 540 | Prepare final report inputs | SCS | Oct 81 | Sep 82 | Selected program | 20 | 115 | 20 | 90 | 245 |
| Total | | | | | | | | | | 814 |
| | | | | | | | | | | 3.7 man years |

Economic

The Economic Work Group will perform all economic analyses related to the study. Included is a basin-wide study of existing and future without project demographic, economic, and agricultural conditions. The work group will provide the economic input needed for formulation of the NED plan and determine the feasibility of individual alternatives.

The economic evaluation will be based on interviews with about 5 percent of the floodplain farmers and other technical personnel. Interviews will be directed toward correlating the damage area and frequency of flooding determined by hydrologists, determining production costs, estimating land use and crop rotations, and documenting other agricultural damages to help develop damage factors. Upland farmers will be interviewed to help determine flood-free yields and cropping patterns. Local and State officials will be contacted to help determine damages to roads, bridges, and utilities.

Benefits from reducing flood damages will be determined using approved procedures. A stage-area-frequency procedure appears best suited to upstream areas; a duration-area-frequency procedure appears appropriate for downstream areas. ECON II will be used where possible in the upstream watersheds. Final determination on procedures will be made after the economist and hydrologist have more extensively examined the damage areas.

Soil scientists and district conservationists in each county will be consulted with to determine the economic benefits derived from cropland enhancement. The economist will determine floodplain land use for with and without project conditions and supply this information to other disciplines as needed.

The economist will:

1. Help the recreation specialist formulate and evaluate recreation plans for any structures that have recreation potential.

2. Assist the soil conservationist in developing land treatment needs and costs.

3. Participate in public meetings and provide assistance to the local sponsors in making decisions relating to the NED components of the alternatives.

The following table summarizes the economics work needed for the study.

Schedule of economic studies

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Estimated time in man-days: Soil Conservation Service | Corps of Engineers | Total |
|---|---|---|---|---|---|---|---|---|
| | I. Problem identification | | | | | | | |
| 601 | Delineate benefit area | SCS/ Corps | Oct 78 | Nov 78 | Map | 20 | 10 | 30 |
| | Office preparation | | | | | | | |
| | Select sample area | SCS/ Corps | Oct 78 | Nov 78 | | 15 | 5 | 20 |
| | Maps and other items needed | SCS/ Corps | Oct 78 | Nov 78 | | 8 | 2 | 10 |
| | Select economic reaches | SCS/ Corps | Oct 78 | Nov 78 | | 8 | 2 | 10 |
| | Data collection | | | | | | | |
| 602 | Field reconnaissance | SCS | Oct 78 | Feb 79 | Tables, narrative | 10 | - | 10 |
| 603 | Field interviews | SCS/ Corps | Nov 78 | Dec 78 | Tables | 40 | 20 | 60 |
| | Technical interviews (district conservationists, soil scientists, resource people) | SCS/ Corps | Nov 78 | Dec 78 | Narrative | 15 | 5 | 20 |
| 604 | Sediment and scouring data | SCS/ Corps | Dec 78 | Jan 79 | | 25 | 15 | 40 |
| 605 | Determine land use | SCS/ Corps | Oct 78 | Nov 78 | | 15 | 15 | 30 |
| 606 | Crop yield data | SCS/ Corps | Dec 78 | Jan 79 | | 20 | - | 20 |
| 607 | Road and bridge data | SCS/ Corps | Nov 78 | Jan 79 | | 25 | 25 | 50 |
| 608 | Land treatment needs | SCS/ Corps | | | | 90 | - | 90 |
| 609 | Soil data | SCS | Nov 79 | Dec 79 | | 10 | - | 10 |
| 610 | Summarize interviews and analyses | SCS/ Corps | Jan 79 | Feb 79 | Tables, charts, narrative | 60 | 30 | 90 |
| | Damage determination | | | | | | | |
| 611 | Develop crop budgets (Crop Budget Generator System) | SCS/ Corps | Feb 79 | Jun 79 | Computer print-outs | 45 | - | 45 |
| 612 | Develop damage values and factors | SCS/ Corps | Feb 79 | Oct 79 | | 90 | 30 | 120 |
| 613 | Run EGON II on upland and appropriate procedures on other areas | SCS/ Corps | Jun 79 | Feb 80 | Computer print-outs | 110 | 20 | 130 |
| 614 | Summarize damages | SCS/ Corps | Mar 80 | Apr 80 | Tables, narrative | 35 | 15 | 50 |
| 615 | Develop present and future damages without project | SCS/ Corps | May 79 | Feb 80 | | 30 | 50 | 80 |
| 616 | Develop other damages (sediment and erosion, roads and bridges) | SCS/ Corps | May 79 | Feb 80 | | 40 | 40 | 80 |

Schedule of economic studies (Cont)

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Estimated time in man-days: Soil Conservation Service | Corps of Engineers | Total |
|---|---|---|---|---|---|---|---|---|
| | II. Plan Formulation and Evaluation | | | | Tables, charts, narrative | | | |
| 617 | Develop damages for various alternatives | SCS/ Corps | May 80 | Oct 80 | | 150 | 100 | 250 |
| 618 | Develop changed land use benefits | SCS/ Corps | May 80 | Jul 80 | | 50 | 20 | 70 |
| 619 | Develop more intensive land use benefits | SCS/ Corps | May 80 | Jul 80 | | 50 | 20 | 70 |
| 620 | Local employment benefits | Corps | Jun 80 | Jul 80 | | - | 10 | 10 |
| 621 | Secondary benefits | SCS | Jul 80 | Aug 80 | | 20 | - | 20 |
| 622 | Drainage benefits | SCS | Jun 80 | Aug 80 | | 50 | - | 50 |
| 623 | Other benefits | Corps | Jun 80 | Aug 80 | | | 30 | 30 |
| 624 | Identify NED plan | SCS/ Corps | Sep 80 | Sep 80 | | 15 | 15 | 30 |
| 625 | Identify EQ plan | SCS/ Corps | Sep 80 | Sep 80 | | 5 | 5 | 10 |
| 626 | Formulation of selected plan | SCS/ Corps | Sep 80 | Oct 80 | | 15 | 15 | 30 |
| 627 | Recreation benefits and needs | SCS/ Corps | May 80 | Aug 80 | | 15 | 15 | 30 |
| | III. Benefit-Cost Estimates | | | | | | | |
| 628 | Cost allocation, cost sharing | SCS/ Corps | Oct 80 | Dec 80 | Tables | 60 | 60 | 120 |
| | IV. Plan Preparation | | | | | | | |
| 629 | Account display, write-up | SCS/ Corps | Dec 80 | Oct 81 | Displays | 80 | 40 | 120 |
| | V. Plan Review | | | | | | | |
| 630 | Attend public meetings | SCS/ Corps | Oct 80 | Oct 82 | | 20 | 15 | 35 |
| 631 | Travel | SCS/ Corps | Oct 80 | Oct 82 | | 10 | 10 | 20 |
| 632 | Draft review | SCS/ Corps | Aug 81 | Oct 81 | | 35 | 35 | 70 |
| 633 | Final review and comments | SCS/ Corps | Apr 82 | Nov 82 | | 40 | 35 | 75 |
| | Total | | | | | 1,316 | 709 | 2,025 |
| | | | | | | 6.0 man-years | 3.2 man-years | 9.2 man-years |

Environmental

The Environmental Work Group will determine the important ecological, cultural, recreation, and social resources of the study area. It will develop plan components (for inclusion in alternatives) to improve the natural and human environments. The environmental assessment process will identify the impacts of alternatives on the study objectives and natural and human environments.

The work group will conduct literature searches, field studies, and evaluations using a systematic, interdisciplinary approach to planning. Work group inputs and monitoring of the study will assure that biological, recreational, cultural, and social resources will be fully considered during planning and decision-making. Study managers will be kept informed of applicable legislation, rules and regulations, guidelines, and executive orders on land and water resources planning to assure full compliance. Liaison with Federal, State, and local groups with expertise or interest in biological, recreational, cultural, and social resources will be maintained throughout the study.

Current and future environmental resources conditions will be determined. In-field evaluations will be conducted at impact zones to provide authoritative basis for preparing reports, recommendations, environmental assessment, account displays, mitigation or enhancement plans, and inputs to the draft report and environmental impact statement.

Four subgroups have been established:

1. Biological Resources Subgroup. - Biologists representing the SCS, Corps, U.S. Fish and Wildlife Service, and State agencies will:

    a. Gather data, conduct field studies, and evaluate the biological resources of the study area.
    b. Determine current and future ecological systems and conditions.
    c. Investigate opportunities to restore, create, or enhance fish and wildlife habitat.

d. Develop environmental quality components to be included in the alternatives.

e. Identify and analyze potential impacts of plan elements on fish and wildlife and ecological systems.

f. Maintain coordination with other work groups so that adverse impacts can be avoided, minimized, or mitigated early in the planning process.

g. Conduct detailed in-field evaluations at selected impact zones.

2. Recreation Resources Subgroup. - Corps of Engineers outdoor recreation planners and landscape architects will coordinate studies of recreation resources with Federal, State, and local agencies and applicable outdoor recreation plans. Overall guidance and coordination responsibility for recreation inputs will be provided by the SCS work group chairperson. The work group will:

a. Investigate and document any recreation demand that could be satisfied by feasible recreation features incorporated in all alternatives. Recreation studies will include feasibility-scope designs and cost estimates of proposed features.

b. Establish the location and extent of any lands required for recreation measures.

c. Determine monetary benefits of satisfying recreation needs.

Project-related features that might be considered include, but are not limited to, camping and picnicking facilities, boat docks, swimming areas, hiking and biking paths, scenic overlooks, and pedestrian bridges and other accesses. Provisions for use of the facilities by the elderly and handicapped will be included in the designs of recreation features. Appropriate drawings, sketches, and illustrations will be included in the report and environmental impact statement. A high degree of public participation will be maintained.

3. Cultural Resources Subgroup. - Corps of Engineers archeologists will coordinate studies of archeological and historical resources with Federal, State, and local agencies. Liaison with State historic preservation officers and the Heritage Conservation and Recreation Service will be established early and maintained to assure full compliance with applicable Federal and State regulations and procedures concerning cultural resources. The work group will also:

a. Conduct literature searches, data collection, field studies, contracts, and evaluations to identify the cultural resources of the study area.

b. Develop cultural improvement components for inclusion in the alternatives.

c. Identify and analyze the potential impacts of plan elements on cultural resources.

d. Maintain coordination with other work groups so that adverse impacts can be avoided, minimized, or mitigated early in the planning process.

A contract with qualified individuals will provide for detailed field investigations at impact zones. Overall guidance and coordination will be the responsibility of the SCS work group chairperson.

4. Social Analysis Subgroup. - Corps of Engineers sociologists will coordinate studies of the social resources with Federal, State, and local agencies. Overall guidance and coordination will be the responsibility of the SCS work group chairperson. Coordination will be maintained with the other work groups so that adverse impacts can be avoided, minimized, or mitigated early in the planning process. All social analyses will be performed in accordance with the expressed and implied intent of the Principles and Standards of the Water Resources Council and all regulations and guidance of the SCS and Corps.

The work group will develop a social profile of the population in the study area. Profile characteristics include data on employment, age distribution, education, and other descriptors which specify the composition and organization of the local social system. The profile will be comparative by providing parallel information on the study area and the State and, on some items, the Nation. The social effects generated by each alternative such as relocation of homes, changes in development patterns, public safety, and aesthetic perceptions will be compared to the base line social profile. Special emphasis will be placed on determining these effects on underprivileged, handicapped, aged, or minority groups. The analysis will estimate, relative to the State or national comparative base, whether the local inhabitants gain or lose with the selection of a given alternative. An assessment and evaluation of the social effects of possible nonstructural and structural plans for the study area and the degree of problem resolution will be made.

Studies will include an institutional analysis to insure that all affected individuals, offices, agencies, and groups are included in the investigation and coordination. An inventory will be compiled of all organizations having functions or interests relevant to water resources planning. The goals, resources, and legal and customary functions of each organization will be specified to give a clear picture of the area's commitments and capabilities. The capability of the existing institutions to implement, manage, and finance each alternative will then be analyzed. Modifications to the existing institutions and/or the need for new institutions will also be investigated.

The following tables present schedules of the Environmental Work Group studies.

Schedule of environmental studies - biological resources subgroup

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Man-days by agency and discipline: SCS Biologist | SCS DC technician | SCS Total | Corps biologist | Other biologists: MDNR | FWS | SDDNR | Other biologists Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage II: Fish and Wildlife Inventories | | | | | | | | | | | | | | |
| 701.1 | Review inventory work for Type IV study. Revise wildlife count and harvest data and habitat inventory to reflect new basin boundary. | SCS | Oct 78 | Dec 78 | Updated tables from Minnesota River basin report | 10 | - | 10 | - | 2 | - | 1 | 3 | 13 |
| | Gather updating wildlife count and harvest data | | Oct 78 | Dec 78 | | 2 | - | 2 | - | 2 | - | 1 | 3 | 5 |
| 701.2 | Inventory number, location, and acreage of lentic bodies 10 acres or larger and the general type of fisheries they support | SCS | Oct 78 | Feb 79 | Maps | 3 | - | 3 | - | 3 | - | 1 | 4 | 7 |
| 701.3 | Location and miles of all continually flowing streams and rivers with general abundance of important fish species (emphasis on trout streams)(1) | SCS | Oct 78 | Feb 79 | Color-coded map showing warm and cold water stream segments | 3 | - | 3 | 3 | 5 | 3 | 2 | 1 | 16 |
| 701.4 | Location of areas particularly notable or important for fish and wildlife (wetland inventory; deer and pheasant winter areas; all WMA's, WPA's, easements, and potential areas; fish spawning areas; endangered species) | SCS | Oct 78 | Feb 79 | Locations on county maps | 5 | 7 | 12 | 5 | 12 | 5 | 2 | 19 | 36 |
| 701.5 | Inventory wildlife habitat by cover type (based on estimates derived from LIM sample plots (40 acres) and comparison to CNI update figures) | SCS | Mar 79 | Oct 79 | Tables | 3 | - | 3 | - | - | - | - | - | 3 |
| 701.6 | Determine average habitat unit values by cover type with 200 random samples and interagency team analyses of collected field data (LIM system with Iowa State)(2) | SCS | Mar 79 | Oct 79 | Narrative descriptions, methods, tables | 25 | 220 | 245 | 20 | 20 | 20 | - | 40 | 305 |
| Stage II: Develop Plan Components and Impact Analyses | | | | | | | | | | | | | | |
| 702.1 | Develop EQ components and predict future without conditions | SCS | Oct 79 | Mar 80 | Tables, maps, narratives | 5 | - | 5 | 5 | 5 | 5 | - | 10 | 20 |
| 702.2 | Impact analysis of NED components by grouping into similar impact areas | SCS | Oct 79 | Mar 80 | Narratives, tables, maps | 100 | - | 100 | 120 | 40 | 40 | - | 80 | 300 |
| 702.3 | Impact analyses of alternatives, displays of accounts Determine mitigation needs | SCS | Jan 80 | Apr 80 | Narratives, tables, interagency reconnaissance biology report | 60 | - | 60 | 60 | 60 | 60 | - | 120 | 240 |
| Stage II: Preliminary Plan and Environmental Assessment | | | | | | | | | | | | | | |
| 703.1 | Draft sections of report and assessment | SCS | Feb 80 | May 80 | Reports, tables, maps | 20 | - | 20 | 20 | 10 | 10 | - | 20 | 60 |
| 703.2 | Coordination and public meetings | | Oct 79 | Sep 80 | | 25 | - | 25 | 25 | 25 | 25 | - | 50 | 100 |
| 703.3 | Review and comment on draft Stage II report and environmental assessment | | May 80 | Sep 80 | Comments | 10 | 10 | 20 | 10 | 10 | 10 | 10 | 30 | 60 |
| Total Stage II | | | | | | | | 508 | 268 | | | | 389 | 1,165 |

Schedule of environmental studies - biological resources subgroup (Cont)

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Man-days by agency and discipline: SCS Biologist | SCS DC technician | SCS Total | Corps biologist | Other biologists MDNR | Other biologists FWS | Other biologists SDDNR | Other biologists Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage III: Reanalysis of Implementable Plans | | | | | | | | | | | | | | |
| 704.1 | Review preliminary data developed during Stage II for updated needs and additional information needs | SCS | Oct 80 | Nov 80 | | 5 | - | 5 | 5 | 5 | 5 | - | 10 | 20 |
| 704.2 | Fish and wildlife habitat appraisals by structure sites (in-field HEP analysis)<br>Prepare for analysis from photos, maps, engineering group<br>Transfer field data to forms and computer analysis of data (3) | SCS | May 80 | Sep 81 | Maps, tables, narrative | 90 | 10 | 100 | 90 | 90 | 90 | - | 180 | 370 |
| 704.3 | Appraisals of sites for fish and wildlife developments, improvements, mitigation, or enhancement | SCS | Sep 80 | Sep 81 | Maps, tables | 20 | 10 | 30 | 20 | 20 | 20 | - | 40 | 90 |
| 704.4 | Update impact analysis of alternatives and display of accounts | SCS | Jan 81 | Sep 81 | Tables, narratives, account displays | 20 | - | 20 | 20 | 20 | 20 | - | 40 | 80 |
| Stage III: Selection of Recommended Plan | | | | | | | | | | | | | | |
| 705.1 | Identify impacts of selected plan elements | SCS | Sep 81 | Dec 81 | Tables, narratives | 20 | 5 | 25 | 20 | 20 | 20 | - | 40 | 85 |
| 705.2 | Trade-off analysis and displays of accounts | SCS | Sep 81 | Dec 81 | Tables, account displays | 25 | - | 25 | 25 | 5 | 5 | - | 10 | 60 |
| 705.3 | Mitigation needs and/or enhancement of selected plan on fish and wildlife resources | SCS/ Corps/ FWS/ DNR | Sep 81 | Feb 82 | Interagency biology report | 20 | 10 | 30 | 20 | 20 | 20 | - | 40 | 90 |
| 705.4 | Coordination and public meetings | | Sep 81 | Mar 82 | | 20 | 10 | 30 | 20 | 20 | 20 | - | 40 | 90 |
| Stage III: Final Report and Environmental Impact Statement | | | | | | | | | | | | | | |
| 706.1 | Draft sections of final report and EIS | SCS | Feb 82 | May 82 | Reports | 60 | - | 60 | 60 | 10 | 10 | - | 20 | 140 |
| 706.2 | Informal review and comment on final report and EIS | SCS | Apr 82 | Jul 82 | Comments | 20 | 20 | 40 | 20 | 40 | 40 | 20 | 100 | 160 |
| 706.3 | Coordination and public meetings | | Mar 82 | Sep 82 | | 10 | 5 | 15 | 10 | 5 | 5 | 5 | 15 | 40 |
| Total Stage III | | | | | | | | 380 | 310 | | | | 535 | 1,225 |

(1) Determine need for fishery surveys (under contract).
(2) Field collection of LIM data by district conservationists. Analysis of raw data by Iowa State and quad-agency team.
(3) Sites grouped into similar impact zones and representative sites evaluated by quad-agency biology team with full FWS HEP.

Note: MDNR - Minnesota Department of Natural Resources.
FWS - Fish and Wildlife Service.
SDDNR - South Dakota Department of Natural Resources.
HEP - Habitat Evaluation Procedures.

Schedule of environmental studies - cultural resources subgroup

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Man-days by agency and discipline: Archeologist (Corps) | Biologist (SCS) | Contractor | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Stage II: Inventory of Cultural Resources** | | | | | | | | | |
| 711.1 | Administer contract for record and literature review, informant contacts at potential reservoir sites, etc. (prepare U.S. Geological Survey maps with approximate boundaries of reservoir sites, channel and levee work, etc.; prepare scope of work and contract; negotiate contract; monitor contract work progress; review contractor report)(1) | Corps | Oct 78 | Sep 79 | Cultural resources report and maps | 80 | 20 | 120 | 220 |
| 711.2 | Coordination and public meetings | | Oct 78 | Sep 79 | | 20 | 5 | – | 25 |
| **Stage II: Develop Plan Components and Analyze Impacts** | | | | | | | | | |
| 712.1 | Develop cultural resources section for alternatives and analyze impacts (develop cultural inputs to EQ plan, analyze impacts of NED components, analyze impacts of alternatives, make input to account displays) | Corps | Oct 79 | Mar 80 | Cultural resources report sections and displays | 55 | 10 | – | 65 |
| **Stage II: Preliminary Plan and Environmental Assessment** | | | | | | | | | |
| 713.1 | Draft sections of report and assessment | Corps | Feb 80 | May 80 | Report sections | | | | |
| 713.2 | Coordination and public meetings | | Oct 79 | Sep 80 | | 7 | 5 | – | 12 |
| 713.3 | Review and comment on draft Stage II report and environmental assessment | | May 80 | Sep 80 | Comments | 5 | 5 | – | 10 |
| Total Stage II | | | | | | 167 | 45 | 120 | 332 |
| **Stage III: Reanalysis of Implementable Plans** | | | | | | | | | |
| 714.1 | Administer contract for reconnaissance survey of proposed structure sites, channel work, and levees (update U.S. Geological Survey maps of impact areas, prepare scope of work and contract, negotiate contract, monitor contract work progress, review contractor report)(2) | Corps | Apr 80 | Apr 81 | Report with completed site forms and recommendations for further detailed testing | 100 | 15 | 700 | 815 |
| 714.2 | Update impact analysis and account displays | | May 81 | Sep 81 | Tables, narratives | 30 | 10 | – | 40 |
| 714.3 | Coordination with other groups | | Apr 80 | Sep 81 | | 15 | 5 | – | 20 |
| **Stage III: Selection of Recommended Plan** | | | | | | | | | |
| 715.1 | Identify impacts of selected plan elements on cultural resources | Corps | Apr 81 | Jan 82 | Report with site maps and updated account displays | 20 | 10 | – | 30 |
| 715.2 | Award and administer contract for intensive testing of selected potential sites of impact areas to determine eligibility and impacts, mitigation, or recovery needs (2) | Corps | Apr 81 | Jan 82 | Cultural report with nominating forms, mitigation recommendations, etc. | 40 | 10 | 400 | 450 |
| 715.3 | Mitigation needs and or enhancement of selected plan on cultural resources | | Dec 81 | Feb 82 | Tables, narratives, reports | 30 | 10 | – | 40 |
| 715.4 | Coordination and public meetings | | Sep 81 | Mar 82 | | 10 | 5 | – | 15 |
| **Stage III: Final Report and Environmental Impact Statement** | | | | | | | | | |
| 716.1 | Draft sections of final report and EIS | | Feb 82 | May 82 | Report sections | 60 | 10 | – | 70 |
| 716.2 | Informal review and comment on final report and EIS | | Apr 82 | Jul 82 | Comments | 20 | 5 | – | 25 |
| 716.3 | Coordination and public meetings | | Sep 81 | Sep 82 | | 10 | 5 | – | 15 |
| Total Stage III | | | | | | 335 | 85 | 1,100 | 1,520 |

| Code | Work item | Responsible agency | Responsible discipline | Starting date | Completion date | Product | Man-days by agency and discipline: Corps of Engineers: Landscape architect | Corps of Engineers: Supervisory landscape architect | Corps of Engineers: Outdoor recreation planner | Corps of Engineers: Total | SCS: Biologist | Other: State recreation: Minnesota | Other: State recreation: South Dakota | Other: Local government | Other: Contractor | Other: Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage II - Inventory of Recreation Resources | | | | | | | | | | | | | | | | | |
| 721.1 | Review previous work done, determine updating needs. Contact local officials for recreation plans, etc., and begin public involvement | Corps | Outdoor recreation planning | Oct 78 | Dec 78 | Possible summary table of existing recreation plans | 8 | 2 | 15 | 25 | - | 1 | 2 | 10 | - | 13 | 38 |
| 721.2 | Obtain State computer printout of existing recreation facilities, review SCORP data for the basin and within an LIA of 50-mile radius, boundary by County | Corps | Outdoor recreation planning | Oct 78 | Dec 78 | Updated inventory of recreation facilities | 8 | 4 | 10 | 22 | 1 | 1 | 5 | - | - | 6 | 29 |
| 721.3 | Analyze present facility capacities and capabilities to determine supply | Corps | Outdoor recreation planning | Dec 78 | Feb 79 | Table of recreation supply | 5 | 2 | 10 | 17 | - | - | - | - | - | - | 17 |
| 721.4 | Analyze recreation demand using SCORP's, population projections and participation rates, comparisons to similar projects | Corps | Outdoor recreation planning | Oct 78 | Mar 79 | Table of recreation demand | 15 | 4 | 30 | 48 | 5 | 5 | 5 | - | - | 10 | 63 |
| 721.5 | Obtain and analyze products of fish and wildlife subgroup (701.2,) and ... for application to recreation task | SCS | Biology and Outdoor recreation planning | Feb 79 | Mar 79 | Incorporate data into previous recreation work item products | 2 | 1 | 10 | 13 | 15 | - | - | - | - | - | 28 |
| 721.6 | Determine recreation needs by various time frames | Corps | Outdoor recreation planning | Jan 79 | Mar 79 | Table of facility and activity needs | 10 | 5 | 10 | 25 | 5 | 5 | 5 | - | - | 10 | 40 |
| 721.7 | Inventory and analyze resources capabilities for recreation development (proposed acquisition areas from county and local plans, single-purpose impoundment sites in the Minnesota River basin Type IV report, etc.) | Corps | Outdoor recreation planning | Jan 79 | Sep 79 | Maps, tables, charts of potential development areas | 40 | 10 | 60 | 110 | 15 | 3 | 10 | 30 | 15 | 58 | 183 |
| 721.8 | Coordination and public meetings - emphasis on coordination with ... analysis subgroup | SCS/ Corps | Biology and Outdoor recreation planning | Oct 78 | Sep 79 | Description of public desires for recreation | 10 | 5 | 25 | 40 | 10 | 10 | 2 | 25 | - | 37 | 87 |
| 722 | Preliminary Plan Components and Impact Analysis | | | | | | | | | | | | | | | | |
| | ... alternatives (NED, EQ, etc.), ... positive and negative ... on recreation, provide ... for planning leaders | Corps | Outdoor recreation planning | Oct 79 | Jan 80 | Matrix, table | 30 | 5 | 40 | 75 | 10 | - | - | - | - | - | 85 |
| | ... potential recreation ... development concepts for ... | Corps | Outdoor recreation planning | Nov 79 | Feb 80 | Drawings, maps, account displays | 80 | 20 | 40 | 140 | 20 | 10 | 10 | 8 | - | 28 | 188 |
| | ... Coding ... present ... ment", | SCS/ Corps | Biology and Outdoor recreation planning | Feb 80 | Mar 80 | Narratives, drawings, plans | 25 | 10 | 25 | 60 | 1 | 10 | 4 | 24 | - | 38 | 111 |
| | ... plans ... | rps | Outdoor recreation planning | Mar 80 | May 80 | Plans, tables, narratives | 40 | 12 | 40 | 92 | 12 | 8 | 8 | 8 | - | 24 | 128 |

AD-A119 415 CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT F/G 13/2
UPPER MINNESOTA RIVER SUBBASINS STUDY (PUBLIC LAW 87-639) (DRAF--ETC(U)
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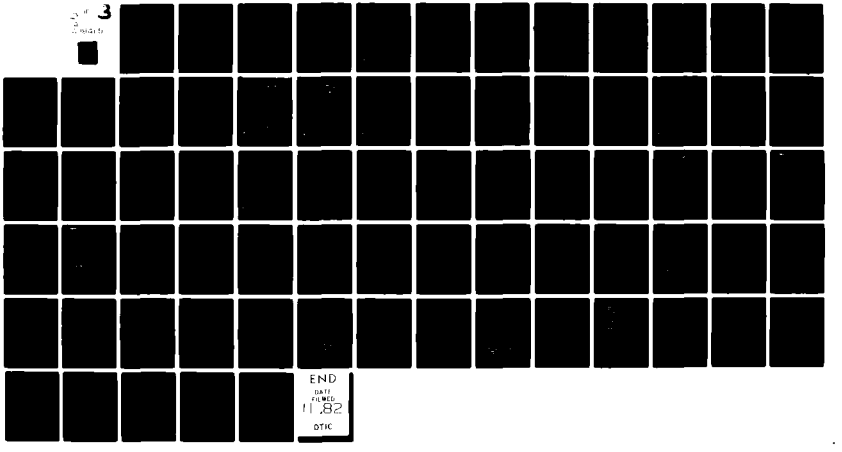


Schedule of environmental studies - recreation resources subgroup (Cont)

| Code | Work item | Responsible agency | Responsible discipline | Starting date | Completion date | Product | Man days by agency and discipline: Corps of Engineers: Landscape architect | Supervisory landscape architect | Outdoor recreation planner | Total | SCS biologist | Other: State recreation: Minnesota | South Dakota | Local government | Contractor | Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stage II: Preliminary Plan and Final Environmental Assessment** | | | | | | | | | | | | | | | | | |
| 723.1 | Develop drafts of report and environmental assessment | Corps | Outdoor recreation planning | May 80 | Jun 80 | Report | 40 | 8 | 80 | 128 | 8 | - | - | - | - | - | 136 |
| 723.2 | Prepare plates and maps for reports | Corps | | May 80 | Jun 80 | | 16 | 24 | 8 | 48 | 4 | 4 | 4 | 4 | - | 12 | 64 |
| 723.3 | Review and comment on draft Stage II report and environmental assessment | Corps | Outdoor recreation planning | May 80 | Sep 80 | Comments | 10 | 10 | 5 | 25 | 5 | 10 | 10 | 10 | - | 30 | 60 |
| 723.4 | Coordination with other work groups | Corps | Outdoor recreation planning | Oct 79 | Sep 80 | | 25 | 25 | 7 | 57 | 10 | - | - | - | - | - | 67 |
| Total Stage II | | | | | | | | | | 925 | 136 | | | | | 266 | 1,327 |
| **Stage III: Reevaluation of Implementable Plans** | | | | | | | | | | | | | | | | | |
| 724.1 | Review of data used in Stage II | Corps | Outdoor recreation planning | Oct 80 | Dec 80 | Updated tables, charts | 16 | 16 | 1 | 33 | 1 | 8 | 8 | 4 | - | 20 | 54 |
| 724.2 | Review appraisals performed by biological resources subgroup to determine effect on proposed recreation development plans. Revise where necessary. | Corps | Outdoor recreation planning | Dec 80 | Sep 81 | Revised site plans, etc. | 40 | 40 | 10 | 90 | 20 | - | - | - | - | - | 110 |
| 724.3 | Present revised plans to public at a series of workshops. Obtain comments. | SCS/ Corps | Biology and outdoor recreation planning | Jun 81 | Sep 81 | Comments | 16 | 24 | 8 | 48 | 8 | 12 | 4 | 32 | - | 48 | 104 |
| 724.4 | Make final revisions to plans, costs, and benefits (updated impact analysis of alternatives and account displays. | Corps | Outdoor recreation planning | Aug 81 | Dec 81 | Plans, tables, account displays | 32 | 24 | 8 | 64 | 4 | - | - | - | - | - | 68 |
| **Stage III: Selection of Recommended Plan** | | | | | | | | | | | | | | | | | |
| 725.1 | Identify impacts of selected plan on recreation resources | Corps | Outdoor recreation planning | Sep 81 | Dec 81 | Tables, narratives | 20 | 20 | 10 | 50 | 5 | 10 | 10 | - | - | 20 | 75 |
| 725.2 | Trade-off analysis and displays of accounts | Corps | Outdoor recreation planning | Sep 81 | Dec 81 | Tables, account displays | 10 | 10 | 5 | 25 | 5 | 5 | 5 | 5 | - | 15 | 45 |
| 725.3 | Mitigation needs and/or benefits of selected plan on recreation resources | Corps | Biology and outdoor recreation planning | Sep 81 | Feb 82 | Tables, narratives | 10 | 10 | 5 | 25 | 5 | 5 | 5 | 5 | - | 15 | 45 |
| 725.4 | Coordination and public meetings | | | Sep 81 | Mar 82 | | 15 | 15 | 5 | 35 | 5 | 5 | 5 | 5 | - | 15 | 55 |
| **Stage III: Final Report and Environmental Impact Statement** | | | | | | | | | | | | | | | | | |
| 726.1 | Draft sections of final report and EIS | Corps | Outdoor recreation planning | Jan 82 | May 82 | Reports | 40 | 60 | 8 | 108 | 24 | 12 | 12 | 40 | - | 64 | 196 |
| 726.2 | Informal review and comment on final report and EIS | Corps | Outdoor recreation planning | Apr 82 | Jul 82 | Comments | | | | | | | | | | | |
| 726.3 | Coordination and public meetings | | | Mar 82 | Sep 82 | | 5 | 5 | 1 | 11 | 2 | 2 | 2 | 2 | - | 6 | 19 |
| Total Stage III | | | | | | | | | | 489 | 136 | | | | | 203 | 771 |

Schedule of environmental studies - social analysis subgroup

| Code | Work item | Respon-sible agency | Start-ing date | Comple-tion date | Product | Man-days by agency and discipline: Corps of Engineers: Sociolo-gist (two) | Super-visor | Total | SCS biologist | Con-tractor | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage II: Social Analysis Inventory | | | | | | | | | | | |
| 731.1 | Social profile (identify significant social factors, determine level of investigation, administer contract for social profile (prepare scope of work and contract, negotiate contract, monitor contract work, review contractor reports, literature search and field interview work) Coordinate with public involvement work group and public meetings(1) | Corps | Oct 78 | Mar 79 | Reports, narratives (projection of alternative future without action) | 12 | 2 | 15 | 2 | 40 | 57 |
| | | Corps | Oct 78 | Mar 79 | | 1 | | | | | |
| 731.2 | Institutional analysis (consult with study managers to establish specific studies needed and scope of analysis, prepare scope of work and contract, administer contract for institutional analysis and monitor contract progress, review contractor reports)(2) | Corps | Oct 78 | Sep 79 | Institutional analysis report | 40 | 5 | 45 | 10 | 120 | 175 |
| Stage II: Develop Plan Components and Analyze Impacts | | | | | | | | | | | |
| 732.1 | Develop possible social well-being improvement components | Corps | Oct 79 | Mar 80 | Reports, narratives | 20 | 2 | 22 | 5 | - | 27 |
| 732.2 | Develop social well-being accounts and analyze impacts of alternatives. Determine possible mitigation plans. | Corps | Jan 80 | Apr 80 | Display accounts, narratives, and reports | 25 | 2 | 27 | 5 | 23 | 55 |
| Stage II: Preliminary Plan and Environmental Assessment | | | | | | | | | | | |
| 733.1 | Draft sections of report and environmental assessment | Corps | Feb 80 | May 80 | Reports, tables, graphs, narratives | 60 | 6 | 66 | 10 | - | 76 |
| 733.2 | Coordination and public meeting | | Oct 79 | Sep 80 | | 16 | 2 | 18 | 4 | 5 | 27 |
| 733.3 | Review and comment on draft Stage II report and environmental assessment | Corps | May 80 | Sep 80 | Comments | 15 | 5 | 20 | 5 | - | 25 |
| Total Stage II | | | | | | | | 213 | 41 | 188 | 442 |
| Stage III: Reanalysis of Implementable Plans | | | | | | | | | | | |
| 734.1 | Review Stage II data for updated needs and additional study needs | Corps | Oct 80 | Dec 80 | Updated preliminary social data | 3 | - | 3 | - | - | 3 |
| 734.2 | In-field investigations of social impacts of alternatives (field-work by contract) (3) | Corps | May 80 | Sep 81 | Maps, tables, narratives | 54 | 5 | 59 | 5 | 160 | 224 |
| 734.3 | Updated impact analysis of alternatives and account displays, mitigation needs. Implementability analysis of remaining plans. | Corps | Jan 81 | Sep 81 | Maps, tables, narratives, account displays | 130 | 3 | 133 | 10 | - | 143 |
| 734.4 | Study recommendations for institutional change based on institutional and implementability analyses | Corps | Apr 81 | Sep 81 | Recommendations for possible changes of institutions to implement and maintain recommended plan | 17 | 2 | 19 | 5 | 10 | 34 |
| Stage III: Selection of Recommended Plan | | | | | | | | | | | |
| 735.1 | Identify social impacts of selected plan elements | Corps | Sep 81 | Dec 81 | Narratives, maps, tables | 20 | - | 20 | 3 | - | 23 |
| 735.2 | Trade-off analysis and displays of selected plan elements | Corps | Sep 81 | Dec 81 | Tables, account displays | 20 | - | 20 | | | 20 |
| 735.3 | Mitigation needs and/or enhancement of selected plan for social well-being | Corps | Sep 81 | Feb 82 | Maps, narratives, tables | 60 | 10 | 70 | 10 | - | 80 |
| 735.4 | Coordination and public meetings | | Sep 81 | Mar 82 | | 10 | - | 10 | 2 | - | 12 |
| Stage III: Final Report and Environmental Impact Statement | | | | | | | | | | | |
| 736.1 | Draft sections of final report and EIS | Corps | Feb 82 | May 82 | Report sections | 40 | 5 | 45 | 10 | - | 55 |
| 736.2 | Informal review and comment on final report and EIS | Corps | Apr 82 | Jul 82 | Comments | 30 | 10 | 40 | 5 | - | 45 |
| 736.3 | Coordination and public meetings | | Mar 82 | Sep 82 | | 7 | 2 | 9 | 3 | - | 12 |
| Total Stage III | | | | | | | | 428 | 53 | 170 | 651 |

(1) Contract estimate = $7,500.
(2) Contract estimate = $23,500.
(3) Contract estimate = $17,500.

## Water Quality

Water quality studies will be done to insure that any proposed projects do not adversely affect the water quality of the study area lakes and streams. Many of the streams and creeks flow intermittently in dry ravines; others are spring-fed. Waters are alkaline with hardness ranging to more than 1,000 mg/l in the western part of the study area. Water quality and hydrologic data for the streams and creeks are almost nonexistent.

Three methods of conducting water quality studies were investigated:

1. Method A would have a water quality and ecosystem mathematical model approach. A set of water quality data for each proposed reservoir site would require at least 2 years of continuous streamflow, temperature, and specific conductance measurements and weekly monitoring of stream water quality for 20 parameters during spring runoffs. Monthly monitoring of water quality is considered sufficient for the rest of the year, except for special monitoring during storms. Costs for this method are estimated at about $200,000 for each site investigated. This figure includes costs for data collection, model study, and a final report. Costs would be excessive if each potential reservoir site were investigated.

2. Method B would involve sampling about five representative reservoirs and five or more sites on nearby streams where impoundments are possible. All trout streams that would be affected would also be sampled. Stream gaging and water quality sampling stations would be required upstream and downstream from each of the existing representative reservoirs and on each of the streams to be sampled. Correlations of data on inflow, pool, and outflow could be made with data collected at the representative stream sites. Weekly sampling of all stations during spring, summer, and fall would be required for 3 years to develop a sufficient data base for statistical reliability. Costs for this method are estimated at $700,000.

3. Under method C, water quality sampling would be confined to only the pools and outlets of existing reservoirs in the study area. The pool data would be used to classify reservoirs according to their relative trophic states and other water quality indexes. Outlet monitoring would determine compliance with water quality standards. This type of sampling program would also provide information on the limnological behavior of the existing impoundments. The information could be evaluated with respect to reservoir morphometry. Land use and other basin characteristics correlations could be used to describe proposed reservoirs. Stream gaging stations and monitoring of flow would not be necessary. The inherent difficulty of obtaining adequate water quality data from intermittent streams would be eliminated. Costs for this method are estimated at $490,000. This cost was used for the study cost estimate.

The range of water quality issues and a method of study were coordinated with representatives of the Environmental Protection Agency, Minnesota Pollution Control Agency, and South Dakota Department of Environmental Protection. The issues and some of the conclusions from discussions during coordination meetings are shown in pertinent letters in appendix B. Generally, the agencies' representatives favored a method of study similar to method B but with monitoring done four times a year.

The Minnesota Pollution Control Agency later expressed in an 8 August 1978 letter that the study method should include predictive modeling, evaluation of the impacts of improvements on downstream water quality and flow, impact of dry dams on water quality, and monitoring of pesticides and herbicides. The Environmental Protection Agency in a 2 August 1978 letter stated the need to alert communities with municipal effluent discharges into potential reservoirs of the potential

need for additional treatment. The South Dakota Environmental Protection Agency, in its 18 July 1978 letter, stated that stream use regulations could not be downgraded by project development, the impacts of dry dams should be judged case by case, three to six reservoirs could adequately represent prospective sites, and frequency of sampling reservoir inflow should depend on its variability which might require more frequent sampling than the four times a year for impoundment and outflow waters.

Method C was used for the following study schedule and study cost estimate. It has the lowest cost of the three methods and would provide the most practical, reliable results. Further coordination between State and Federal agencies is required before adopting a specific method for water quality studies.

Schedule for water quality studies

| Code | Work item | Responsible agency | Starting date | Completion date | Product | Man-days by agency: Corps of Engineers: Engineer | Technician | Secretary | Total | SCS engineer | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 800 | Obtain reservoir land use and damage maps | Corps | Dec 78 | Jan 79 | U.S. Geological Survey maps | 60 | - | - | 60 | 6 | 66 |
| 810 | Land use analysis of reservoir damage areas | Corps | Jan 79 | Jan 80 | Land use percentage tabulation for each reservoir drainage area | 240 | - | - | 240 | 24 | 264 |
| 820 | Field reconnaissance | Corps | May 79 | Jan 80 | Inventory of access roads, local feedlots, topography, land use, sources of water, and water use | 60 | - | - | 60 | 6 | 66 |
| 825 | Water quality inputs to preliminary report and environmental assessment | Corps | Oct 80 | Feb 81 | Preliminary report and environmental assessment | 120 | 40 | 40 | 200 | 12 | 212 |
| 830 | Selection of representative sites | Corps | Jan 80 | Jan 80 | Identify sample sites | 10 | - | - | 10 | 2 | 12 |
| 840 | Prepare and execute contract for sampling | Corps | Feb 80 | Feb 80 | Select contractor | 20 | - | - | 20 | 3 | 23 |
| 850 | Sample | Corps | Mar 80 | Mar 82 | Samples | 30 | 180 | 7 | 217 | 4 | 221 |
| 860 | Sample analysis | Corps | Mar 80 | Mar 82 | Analysis of samples | - | 217 | - | 217 | - | 217 |
| 870 | Data review and analysis | Corps | Mar 81 | Apr 82 | Tabulations, graphs, correlations | 250 | - | - | 250 | 25 | 275 |
| 875 | Inputs to formulation and evaluation of alternatives | Corps | Apr 81 | Dec 81 | Tabulations | 60 | - | - | 60 | 6 | 66 |
| 880 | Water quality inputs to draft feasibility report and EIS | Corps | Dec 81 | Sep 82 | Reports | 60 | - | - | 60 | 6 | 66 |
| 890 | Final report | Corps | Apr 82 | Sep 82 | Water quality report | 160 | 160 | 160 | 480 | 16 | 496 |
| Total | | | | | | | | | 1,874 | 110 | 1,984 |

## WORK SCHEDULE

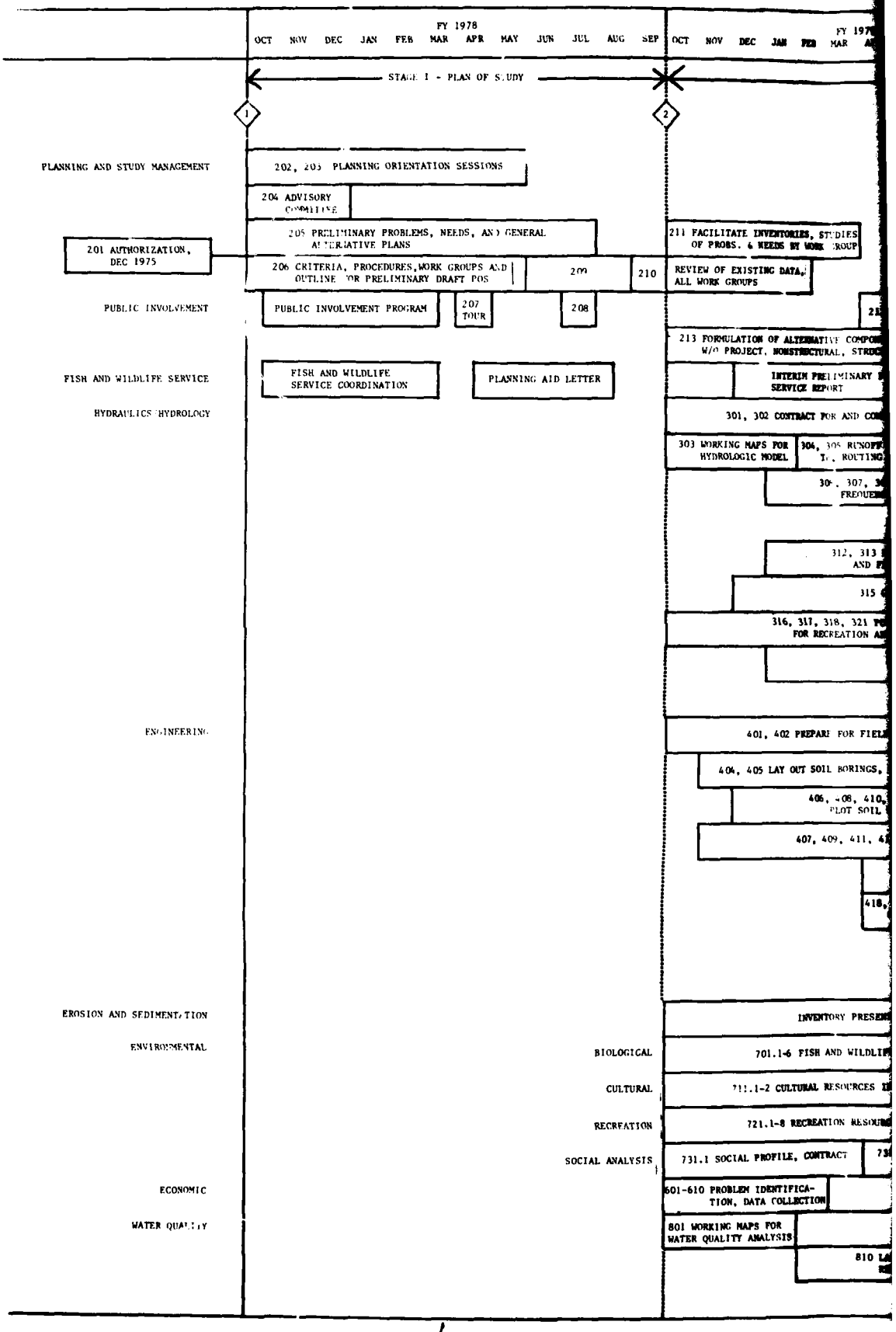
Stage I of the study, which began in October 1977, is concluded with this report. When approved, this report will serve as the basis for more extensive evaluation in Stages II and III. Stages II and III are expected to require a minimum of 4 1/2 years to complete.

Stage II will begin in October 1978 and require about 2½ years. Its product will be an interim preliminary report and environmental assessment presenting greater detail on the problems of the study area and alternatives. A major effort will be made to identify all possible alternative study components during the first year of Stage II. An alternatives report would be produced under the 8-year study schedule (see the table on page 178). Because of time limitations, components considered would be included in the Stage II preliminary feasibility report only under the shorter study schedules.

Stage III will involve coordination of various plan components and formulation of detailed alternatives to determine the NED, EQ, and selected plans. These plans will be presented in the final report and revised draft environmental impact statement.

The following study schedule shows the parallel relationship and sequencing of major work group items. Details on the work items can be found by sequence code numbers in the work group outlines in the previous section.

A detailed public involvement program will be conducted throughout the study. The various public forums are shown on the study schedule. The main objective of this program is to provide sufficient information to the various segments of the public and obtain input needed to formulate responsive, meaningful alternatives.


FY 1978
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
OCT NOV DEC JAN FEB MAR
STAGE I - PLAN OF STUDY
1
2
PLANNING AND STUDY MANAGEMENT
202, 203 PLANNING ORIENTATION SESSIONS
204 ADVISORY COMMITTEE
205 PRELIMINARY PROBLEMS, NEEDS, AND GENERAL ALTERNATIVE PLANS
201 AUTHORIZATION, DEC 1975
206 CRITERIA, PROCEDURES, WORK GROUPS AND OUTLINE FOR PRELIMINARY DRAFT POS
209
210
211 FACILITATE INVENTORIES, STUDIES OF PROBS. & NEEDS BY WORK GROUP
REVIEW OF EXISTING DATA, ALL WORK GROUPS
PUBLIC INVOLVEMENT
PUBLIC INVOLVEMENT PROGRAM
207 TOUR
208
213 FORMULATION OF ALTERNATIVE COMPON
W/O PROJECT, NONSTRUCTURAL, STRUC
FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE SERVICE COORDINATION
PLANNING AID LETTER
INTERIM PRELIMINARY
SERVICE REPORT
HYDRAULICS HYDROLOGY
301, 302 CONTRACT FOR AND CO
303 WORKING MAPS FOR HYDROLOGIC MODEL
304, 305 RUNOFF
307,
FREQUE
312, 313
AND F
315
316, 317, 318, 321 F
FOR RECREATION A
ENGINEERING
401, 402 PREPARE FOR FIEL
404, 405 LAY OUT SOIL BORINGS,
406, 408, 410,
PLOT SOIL
407, 409, 411,
418,
EROSION AND SEDIMENTATION
INVENTORY PRESE
ENVIRONMENTAL
BIOLOGICAL
701.1-6 FISH AND WILDLI
CULTURAL
711.1-2 CULTURAL RESOURCES I
RECREATION
721.1-8 RECREATION RESOUR
SOCIAL ANALYSIS
731.1 SOCIAL PROFILE, CONTRACT
ECONOMIC
601-610 PROBLEM IDENTIFICATION, DATA COLLECTION
WATER QUALITY
801 WORKING MAPS FOR WATER QUALITY ANALYSIS
810 L

STUDY SCHEDULE

FY 1979: NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
FY 1980: OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
FY 1981: OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP

STAGE II - DEVELOPMENT OF PRELIMINARY REPORT AND ENVIRONMENTAL ASSESSMENT

◇1 ◇4 ◇5

FACILITATE INVENTORIES, STUDIES OF PROBS. & NEEDS BY AGENCY STAFF

VIEW OF EXISTING DATA, WORK GROUPS

211

PUBLIC INVOLVEMENT PROGRAM

216

213 FORMULATION OF ALTERNATIVE COMPONENTS, NO ACTION PRESENT, FUTURE W/O PROJECT, NONSTRUCTURAL, STRUCTURAL CONDITIONS

214 PRELIM. PLAN FORM., SED.,EQ, MIX COMPONENTS, COSTS IMPACTS

215 PRELIM. EVALUATION OF ALTERN., IMPACTS, CRITERIA, DRAFT SOA

217 PRELIM RPT & ENV ASSMNT

218 COORD

219

220

221 FINAL FORMULATION OF ALTERNATIVES

INTERIM PRELIMINARY FISH AND WILDLIFE SERVICE REPORT

PRELIMINARY FISH AND WILDLIFE SERVICE REPORT

INTERIM FISH AND WILDLIFE SERVICE FINAL REPORT

301, 302 CONTRACT FOR AND COMPLETION OF TOPOGRAPHIC MAPS OF FLOODPLAIN AND CHANNEL-BRIDGE SURVEYS

303 WORKING MAPS FOR HYDROLOGIC MODEL

304, 305 RUNOFF NOS. I., ROUTING COEFF.

125 REFINE AND VERIFY MODELS

306, 307, 308, 309 HSP MODEL FOR RANGE OF Q's, COMPLETE VOP STUDIES, ESTABLISH RUNOFF FREQUENCIES, RUN HSP's RANGE OF FREQUENCIES

313 ESTABLISH SEASONAL DISTRIBUTION OF FLOODS

310, 311 EXISTING CONDITION, AREA FLOOD FREQUENCY DATA AND MAPS

312, 314 ELEVATION-DISCHARGE DATA FOR ROADS AND BRIDGES, DETERMINE BANK EROSION AND FLOODPLAIN SCOUR

315 COMPLETE ALL DATA FOR ECONOMIC ANALYSIS OF EXISTING FLOOD DAMAGES

326 FINAL ECON ANALYSIS EXISTING FLOOD DAMAGES

316, 317, 318, 321 POTENTIAL RESERVOIRS, INVENTORY, ESTABLISH HAZARD CLASS, EVALUATE POTENTIAL FOR RECREATION AND FISH & WILDLIFE, COMPLETE HYDRAULIC DESIGN

127 REFINE AND VERIFY HYDRAULIC DESIGN OF SPILLWAYS

319, 320 CHANNELS AND LEVEES EVALUATION AND HYDRAULIC DESIGN

128 REFINE AND VERIFY HYDRAULIC DESIGN OF CHANNELS AN

322, 323 EVALUATE AND DISPLAY ALTERNATIVES

324

129 REFINE DATA FOR EVALUATION OF NONSTRUCTURAL ALTE

401, 402 PREPARE FOR FIELD RECONNAISSANCE

406, 405 LAY OUT SOIL BORINGS, DETERMINE ITEMS TO BE INVESTIGATED

406, 408, 410, 412, 414 OBTAIN SOIL BORINGS, LAB TESTING, TIE IN SOIL BORINGS FOR SOIL BORINGS, ANALYZE TEST RESULTS

434,435, 436, 437, 438, 439, 441

407, 409, 411, 413 ESTABLISH L OF DAMS, LAYOUTS, SURVEYS AND NOTES

441,443,440, 442 CONFIRM L OF DAMS, SURVEYS

415, 416, 417 PREPARE SOILS AND MAPS, DETERMINE SEDIMENT STORAGE REQUIREMENTS, FLOODPLAIN DAMAGES, SCOUR AND CUTLY

418, 419, 420, 421, 422, 423, 424, 425 STABILITY, SEEPAGE & SEDIMENT, DESIGN, LAY OUT, EARTHWORK QUANTITIES, STRUCTURE DESIGN, QUANTITIES, COORDINATION

443, 444, 445, 446, 447 REFINE & AND STRUCTURAL QUANTITIES

426, 427 INITIAL COST ESTIMATES

448, 449 P

428, 429, 430 PRELIM RPT AND ENVIRONMENTAL ASSESSMENT INPUTS
*701.1 1, 711.1 2, 722.4, 723.1 2, 733.1 2*

431, 432 REVIEW AND EVALUATE STAGE II WORK
*706.1, 711.1, 721.1-4*

INVENTORY PRESENT DATA

PRELIMINARY REPORT AND ENVIRONMENTAL ASSESSMENT INPUTS

DEVELOP LAND TREATMENT PROGRAMS

701.1-6 FISH AND WILDLIFE INVENTORIES

702.1-3 PLAN COMPONENTS AND IMPACT ANALYSIS

706.2 1, 714.1 FISH & WILDLIFE HABITAT APPRAISALS BY STRUCTURE SITES, ARCHEOLOGICAL APPRAISALS BY STRUCTURE SITES, CONTRACT

711.1-2 CULTURAL RESOURCES INVENTORIES, CONTRACT

712.1 PLAN COMPONENTS AND IMPACT ANALYSIS

706.4, 714.2, 726.1-4, 734.1-4 REFINE EVALUATIONS, ACCOUNT DISPLAYS FOR ALTERNATIVE PLANS

721.1-8 RECREATION RESOURCES INVENTORIES

722.1 PLAN COMPONENTS AND IMPACT ANALYSIS

715.1-4, 725.1-4 INPUTS TO

731.1 SOCIAL PROFILE, CONTRAC

732.1 INSTITUTIONAL ANALYSIS, CONTRACT

732.1 2 PLAN COMPONENTS AND IMPACT ANALYSIS

733.1 REVIEW AND EVALUATE STAGE II WORK

601-610 PROBLEM IDENTIFICATION, DATA COLLECTION

611-616 DETERMINATION OF DAMAGES FOR INTERIM REPORT

617 627 FORMULATION & EVALUATION OF PLANS

628 BENEFIT COST

629 REFINE PLAN EVALUATION AND ACCOUNT DISPLAY

801 WORKING MAPS FOR WATER QUALITY ANALYSIS

820 FIELD RECONNAISSANCE

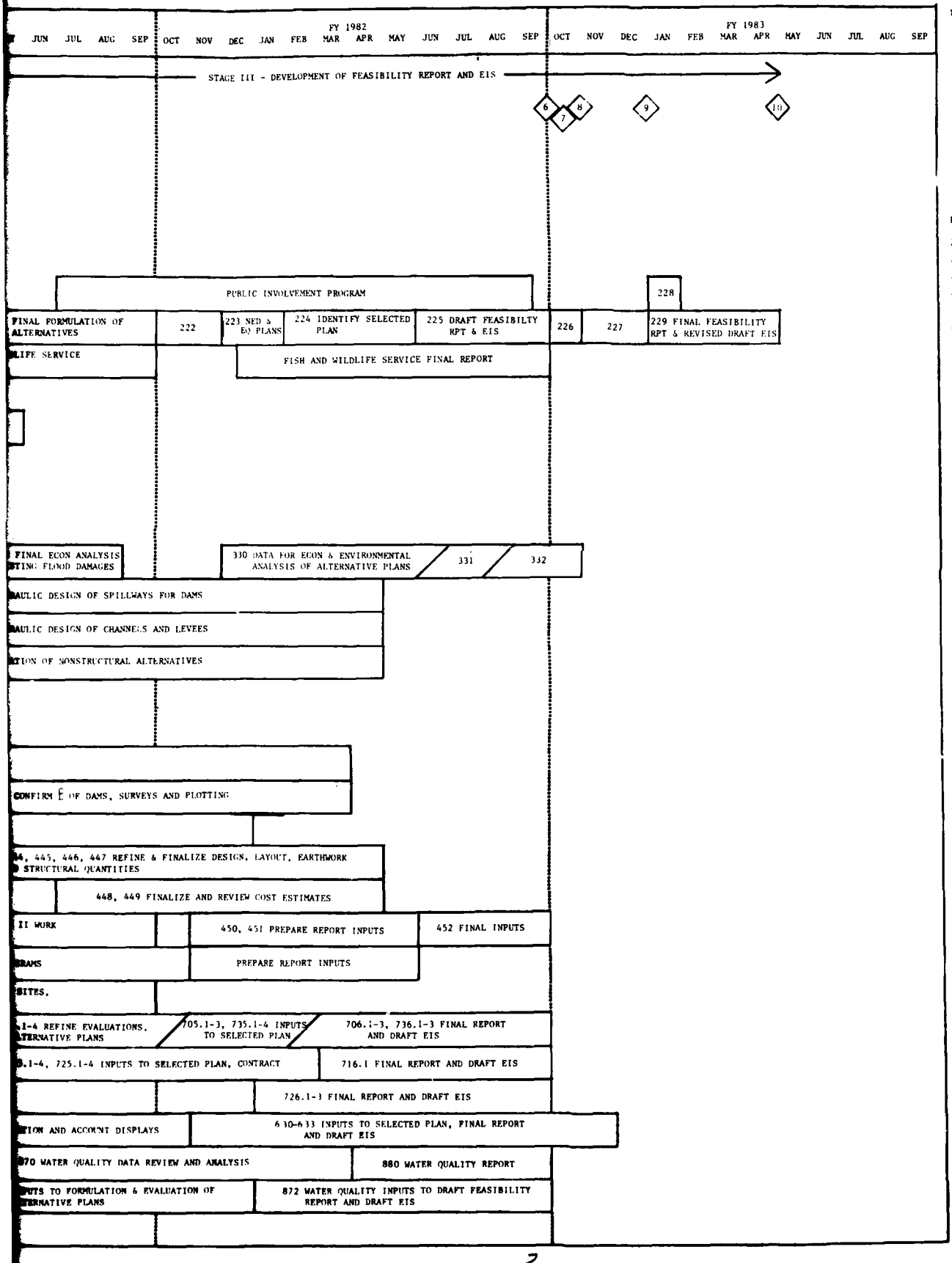
821 WATER QUALITY INPUTS TO PRELIMINARY RPT & ENV ASSMNT

870 WATER QUALITY DATA

810 LAND USE ANALYSIS AND SELECTION OF REPRESENTATIVE RESERVOIR SITES, SAMPLING CONTRACT, SAMPLING AND ANALYSIS

830 840 850 860

871 INPUTS TO FORMULATION & EV ALTERNATIVE PLANS




WORK GROUPS AND SEQUENCE CODING NUMBERS AR

| | |
|---|---|
| 100 | PUBLIC INVOLVEMENT |
| 200 | PLANNING AND STUDY MANAGEMENT |
| 300 | HYDROLOGY AND HYDRAULICS |
| 400 | ENGINEERING |
| 500 | EROSION AND SEDIMENTATION |
| 600 | ECONOMICS |
| 700 | ENVIRONMENTAL |
| 800 | WATER QUALITY |

KEY:

| | |
|---|---|
| 208 | PUBLIC MEETING, TOUR |
| 209 | COMPLETE COORDINATION AND INITIATE |
| 210 | FINAL PLAN OF STUDY |
| 212 | PUBLIC WORKSHOPS |
| 216 | PUBLIC MEETING |
| 219 | CHECKPOINT CONFERENCE AND MFR |
| 220 | PROBLEMS AND NEEDS |
| 222 | TRADE-OFFS AND SYSTEM OF ACCOUNTS |
| 226 | CHECKPOINT CONFERENCE AND MFR |
| 227 | COORDINATE DRAFT REPORT & EIS |
| 228 | PUBLIC MEETING |
| 324 | PRELIMINARY REPORT AND ENVIRONMENTAL |
| 331 | SELECTED PLAN |
| 332 | FINAL REPORT AND DRAFT EIS |

MILESTONES

1. INITIATE STUDY
2. APPROVAL OF PLAN OF STUDY
3. SUBMIT PRELIMINARY FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT
4. STAGE II CHECKPOINT CONFERENCE
5. APPROVAL OF CHECKPOINT CONFERENCE STUDY DIRECTION
6. SUBMIT DRAFT REPORT AND EIS
7. STAGE III CHECKPOINT CONFERENCE
8. APPROVAL OF CHECKPOINT CONFERENCE
9. COORDINATION OF DRAFT REPORT AND STATE, AND FEDERAL AGENCIES
10. SUBMIT FINAL REPORT AND REVISED DR

N

3

## STUDY COST ESTIMATE

The total study cost is estimated at $7,373,000. This estimate allows for contingencies and administrative overhead in accomplishing the work. The following table is a summary of the study cost estimate and manpower requirements.

Summary of costs and manpower requirements

| Major work item | Costs | | Man-years | | Total | |
|---|---|---|---|---|---|---|
| | Corps | SCS | Corps | SCS | Costs | Man-years |
| Public involvement | $53,000 | $53,000 | 1.3 | 1.3 | $106,000 | 2 |
| Planning and study management | 590,000 | 635,000 | 13.2 | 14.7 | 1,225,000 | 27 |
| Economics(1) | (116,000) | (209,000) | (3.2) | (6.0) | (325,000) | (9 |
| Hydrology and hydraulics | 1,060,000 | 504,000 | 25.5 | 15.4 | 1,564,000 | 40. |
| Engineering | 1,644,000 | 1,640,000 | 34.6 | 37.3 | 3,284,000 | 71.9 |
| Environmental | 788,000 | 226,000 | 14.2 | 6.1 | 1,014,000 | 20.3 |
| Erosion and sedimentation | - | 140,000 | - | 3.7 | 140,000 | 3.7 |
| Fish and Wildlife Service | 40,000 | - | - | - | 40,000 | - |
| Total | 4,175,000 | 3,198,000 | 88.8 | 78.5 | 7,373,000(2) | 167.3 |

(1) Economics subitem is included in planning and study management.
(2) Includes $1,338,000 for contracts ($599,000 - Corps, $739,000 - SCS).

The study cost estimate, schedule, and manpower requirements shown on the following table are based on needs identified by the work groups. The cost estimate and proposed study schedule exceed the fiscal year 1979 study funding levels and manpower capabilities of the Corps and SCS. Alternative funding levels and probable manpower capabilties were analyzed and are displayed in the tables on pages 177 and 178. The table on page 177 shows the study effort adjusted according to expected funding in fiscal year 1979. As a result, the study period is extended about 6 months. The table on page 178 displays annual funding and total manpower requirements on the basis of an 8-year study period. The staffing levels are those that could reasonably be attained. The table on page 179 is the summary of manpower requirements for study conditions shown in the tables on pages 176, 177, and 178.

STAGE I — POS

STAGE II — Preliminary report and environmental assessment

STAGE III — Feasibility report and EIS (1 May 83)

Study cost estimate and manpower requirements

| Study item | Cost estimate, Fiscal year 1978 Corps | 1978 SCS | 1979 Corps | 1979 SCS | 1980 Corps | 1980 SCS | 1981 Corps | 1981 SCS | 1982 Corps | 1982 SCS | 1983 Corps | 1983 SCS | Total Corps | Total SCS | Total Combined | Man-years Corps | Man-years SCS | Man-years Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Public Involvement | $3,000 | $3,000 | $5,000 | $5,000 | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | $15,000 | $15,000 | $53,000 | $53,000 | $106,000 | 1.3 | 1.3 | 2.6 |
| Planning and Study Management | | | | | | | | | | | | | | | | | | |
| Economics | 1,000 | 5,000 | 22,000 | 44,000 | 27,000 | 45,000 | 26,000 | 45,000 | 25,000 | 44,000 | 15,000 | 26,000 | 116,000 | 209,000 | 325,000 | 3.2 | 6.0 | 9.2 |
| Formulation | 1,000 | 1,000 | 30,000 | 30,000 | 50,000 | 42,000 | 45,000 | 40,000 | 50,000 | 44,000 | 30,000 | 24,000 | 206,000 | 183,000 | 389,000 | 6.0 | 5.2 | 11.2 |
| Study management | 16,000 | 18,000 | 26,000 | 23,000 | 27,000 | 24,000 | 30,000 | 27,000 | 33,000 | 30,000 | 20,000 | 17,000 | 152,000 | 139,000 | 291,000 | 4.0 | 3.5 | 7.5 |
| Coordination and report preparation | 3,000 | 3,000 | 22,000 | 20,000 | 22,000 | 20,000 | 25,000 | 22,000 | 28,000 | 24,000 | 16,000 | 15,000 | 116,000 | 104,000 | 220,000 | - | - | - |
| Total | 21,000 | 27,000 | 100,000 | 117,000 | 126,000 | 131,000 | 126,000 | 134,000 | 136,000 | 142,000 | 81,000 | 84,000 | 590,000 | 635,000 | 1,225,000 | 13.2 | 14.7 | 27.9 |
| Hydrology and Hydraulics | | | | | | | | | | | | | | | | | | |
| Hydrology | 5,000 | 11,000 | 37,000 | 93,000 | 37,000 | 93,000 | 21,000 | 53,000 | 10,000 | 26,000 | 6,000 | 15,000 | 116,000 | 291,000 | 407,000 | 3.3 | 10.0 | 13.3 |
| Hydraulics | 5,000 | 3,000 | 136,000 | 44,000 | 136,000[1] | 44,000 | 78,000[1] | 25,000 | 38,000 | 12,000 | 22,000 | 7,000 | 415,000[1] | 135,000 | 550,000 | 13.7 | 4.9 | 18.6 |
| Water quality | 8,000 | 3,000 | 73,000 | 5,000 | 118,000[1] | 5,000 | 93,000[1] | 5,000 | 80,000 | 5,000 | 23,000 | 5,000 | 395,000[1] | 28,000 | 423,000 | 8.5 | 0.5 | 9.0 |
| Coordination and report preparation | 4,000 | 4,000 | 26,000 | 10,000 | 33,000 | 10,000 | 30,000 | 10,000 | 32,000 | 10,000 | 9,000 | 6,000 | 134,000 | 50,000 | 184,000 | - | - | - |
| Total | 22,000 | 21,000 | 272,000 | 152,000 | 324,000 | 152,000 | 222,000 | 93,000 | 160,000 | 53,000 | 60,000 | 33,000 | 1,060,000 | 504,000 | 1,564,000 | 25.5 | 15.4 | 40.9 |
| Engineering | | | | | | | | | | | | | | | | | | |
| Topographic mapping | - | 202,000[2] | - | 309,000[2] | - | 114,000[2] | - | 114,000[2] | - | - | - | - | - | 739,000[2] | 739,000[2] | - | 4.0 | 4.0 |
| Surveys | - | - | 140,000[3] | - | 140,000[3] | - | 35,000 | - | 20,000 | - | - | - | 335,000[3] | - | 335,000 | 3.1 | - | 3.1 |
| Drilling and testing | - | - | 80,000 | 40,000 | 120,000 | 40,000 | 150,000 | 40,000 | 80,000 | 10,000 | 74,000 | - | 504,000 | 130,000 | 634,000 | 6.5 | 6.7 | 13.2 |
| Foundation design | 2,000 | 1,000 | 50,000 | 16,000 | 80,000 | 70,000 | 80,000 | 70,000 | 70,000 | 70,000 | 63,000 | - | 345,000 | 227,000 | 572,000 | 12.4 | 8.6 | 21.0 |
| Geology | 2,000 | 2,000 | 10,000 | 22,000 | 16,000 | 22,000 | 10,000 | 22,000 | 10,000 | 11,000 | 10,000 | - | 58,000 | 79,000 | 137,000 | 1.5 | 2.6 | 4.1 |
| Structural design | 1,000 | 1,000 | 16,000 | 15,000 | 40,000 | 65,000 | 40,000 | 75,000 | 40,000 | 70,000 | 10,000 | 15,000 | 147,000 | 241,000 | 388,000 | 5.2 | 8.9 | 14.1 |
| Real estate | - | - | 18,000 | 3,000 | 18,000 | 5,000 | 18,000 | 5,000 | 36,000 | 5,000 | - | - | 90,000 | 18,000 | 108,000 | 2.7 | 0.5 | 3.2 |
| Cost estimates | - | - | 4,000 | 6,000 | 7,000 | 15,000 | 15,000 | 24,000 | 15,000 | 20,000 | 5,000 | 10,000 | 46,000 | 75,000 | 121,000 | 1.7 | 3.5 | 5.2 |
| Drafting | 1,000 | 1,000 | 2,000 | 4,000 | 2,000 | 4,000 | 8,000 | 15,000 | 8,000 | 15,000 | 4,000 | 8,000 | 25,000 | 47,000 | 72,000 | 1.5 | 2.5 | 4.0 |
| Coordination and report preparation | 3,000 | 2,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 19,000 | 10,000 | 94,000 | 84,000 | 178,000 | - | - | - |
| Total | 9,000 | 209,000 | 338,000 | 433,000 | 441,000 | 353,000 | 374,000 | 383,000 | 297,000 | 219,000 | 185,000 | 43,000 | 1,644,000 | 1,640,000 | 3,284,000 | 34.6 | 37.3 | 71.9 |
| Environmental | | | | | | | | | | | | | | | | | | |
| Biological | 2,000 | 5,000 | 17,000[4] | 23,000 | 17,000[4] | 23,000 | 17,000[4] | 23,000 | 17,000 | 23,000 | 10,000 | 13,000 | 80,000[4] | 110,000 | 190,000[4] | 2.6 | 4.1 | 6.7 |
| Cultural | 2,000 | 1,000 | 25,000[4] | 4,000 | 136,000[4] | 4,000 | 85,000[4] | 4,000 | 10,000 | 4,000 | 6,000 | 1,000 | 264,000[4] | 18,000 | 282,000[4] | 2.3 | 0.6 | 2.9 |
| Recreation | 1,000 | 1,000 | 46,000[5] | 7,000 | 47,000 | 8,000 | 34,000 | 7,000 | 27,000 | 5,000 | 15,000 | 2,000 | 170,000 | 30,000 | 200,000[5] | 6.4 | 1.0 | 7.4 |
| Social | 5,000 | 1,000 | 40,000 | 2,000 | 28,000 | 2,000 | 17,000 | 3,000 | 21,000 | 2,000 | 13,000 | 2,000 | 124,000[5] | 12,000 | 136,000 | 2.9 | 0.4 | 3.3 |
| Coordination and preparation of EIS | 1,000 | 1,000 | 20,000 | 7,000 | 21,000 | 8,000 | 36,000 | 13,000 | 45,000 | 17,000 | 27,000 | 10,000 | 150,000 | 56,000 | 206,000 | - | - | - |
| Total | 11,000 | 9,000 | 148,000 | 43,000 | 249,000 | 45,000 | 189,000 | 50,000 | 120,000 | 51,000 | 71,000 | 28,000 | 788,000 | 226,000 | 1,014,000 | 14.2 | 6.1 | 20.3 |
| Erosion and Sedimentation | | | | | | | | | | | | | | | | | | |
| Land use | - | 2,000 | - | 25,000 | - | 25,000 | - | 20,000 | - | 20,000 | - | - | - | 92,000 | 92,000 | - | 2.4 | 2.4 |
| Program development | - | 1,000 | - | 5,000 | - | 10,000 | - | 10,000 | - | 22,000 | - | - | - | 48,000 | 48,000 | - | 1.3 | 1.3 |
| Total | - | 3,000 | - | 30,000 | - | 35,000 | - | 30,000 | - | 42,000 | - | - | - | 140,000 | 140,000 | - | 3.7 | 3.7 |
| Fish and Wildlife (agreement between Corps and Fish and Wildlife Service) | 4,000 | - | 10,000 | - | 14,000 | - | 7,000 | - | 5,000 | - | - | - | 40,000 | - | 40,000[6] | - | - | - |
| Total | 70,000 | 272,000 | 873,000 | 780,000 | 1,164,000 | 726,000 | 928,000 | 700,000 | 728,000 | 517,000 | 412,000 | 203,000 | 4,175,000 | 3,198,000 | 7,373,000 | 88.8 | 78.5 | 167.3 |

(1) Includes water quality contract, total $74,000 (Corps).
(2) Contracts (SCS), total $739,000.
(3) Includes survey contract, total $260,000 (Corps).
(4) Includes contracts, total of $216,000 (Corps).
(5) Includes contracts, total of $49,000 (Corps).
(6) Agreements with Fish and Wildlife Service (Corps).

STAGE I — POS | STAGE II — Preliminary report and environmental assessment (1 Aug 81) | STAGE III — Feasibility report and EIS (1 Oct 82)

Study cost estimate and manpower requirements (based on FY 1979 budget limitation)

| Study item | Cost estimate (Fiscal year) 1978 Corps | 1978 SCS | 1979 Corps | 1979 SCS | 1980 Corps | 1980 SCS | 1981 Corps | 1981 SCS | 1982 Corps | 1982 SCS | 1983 Corps | 1983 SCS | Total Corps | Total Combined | Man-years Corps | Man-years SCS | Man-years Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Public Involvement | $3,000 | $3,000 | $5,000 | $5,000 | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | $15,000 | $15,000 | $53,000 | $106,000 | 1.3 | 1.3 | 2.6 |
| Planning and Study Management | | | | | | | | | | | | | | | | | |
| Economics | 1,000 | 5,000 | 22,000 | 44,000 | 27,000 | 45,000 | 26,000 | 45,000 | 25,000 | 44,000 | 15,000 | 26,000 | 116,000 | 209,000 | 325,000 | 3.2 | 6.0 | 9.2 |
| Formulation | 1,000 | 1,000 | 20,000 | 20,000 | 50,000 | 42,000 | 45,000 | 40,000 | 50,000 | 42,000 | 40,000 | 36,000 | 206,000 | 183,000 | 389,000 | 6.0 | 5.2 | 11.2 |
| Study management | 16,000 | 18,000 | 20,000 | 20,000 | 27,000 | 24,000 | 30,000 | 27,000 | 33,000 | 30,000 | 26,000 | 20,000 | 152,000 | 139,000 | 291,000 | 4.0 | 3.5 | 7.5 |
| Coordination and report preparation | 3,000 | 3,000 | 18,000 | 15,000 | 22,000 | 20,000 | 25,000 | 22,000 | 28,000 | 27,000 | 20,000 | 20,000 | 116,000 | 104,000 | 220,000 | - | - | - |
| Total | 21,000 | 27,000 | 80,000 | 99,000 | 126,000 | 131,000 | 126,000 | 134,000 | 136,000 | 142,000 | 101,000 | 102,000 | 590,000 | 635,000 | 1,225,000 | 13.2 | 14.7 | 27.9 |
| Hydrology and Hydraulics | | | | | | | | | | | | | | | | | |
| Hydrology | 5,000 | 11,000 | 21,000 | 50,000 | 37,000 | 93,000 | 27,000 | 93,000 | 15,000 | 29,000 | 11,000 | 15,000 | 116,000 | 291,000 | 407,000 | 3.3 | 10.0 | 13.3 |
| Hydraulics | 5,000 | 3,000 | 76,000 | 30,000 | 136,000(1) | 44,000 | 78,000(1) | 35,000 | 78,000 | 16,000 | 42,000 | 7,000 | 415,000 | 135,000 | 550,000 | 13.7 | 4.9 | 18.6 |
| Water quality | 6,000 | 3,000 | 42,000 | 5,000 | 116,000 | 5,000 | 93,000 | 3,000 | 80,000 | 5,000 | 55,000 | 5,000 | 395,000 | 28,000 | 423,000 | 8.5 | 0.5 | 9.0 |
| Coordination and report preparation | 4,000 | 4,000 | 13,000 | 10,000 | 33,000 | 10,000 | 30,000 | 10,000 | 32,000 | 10,000 | 22,000 | 6,000 | 134,000 | 50,000 | 184,000 | - | - | - |
| Total | 22,000 | 21,000 | 151,000 | 95,000 | 324,000 | 152,000 | 228,000 | 143,000 | 205,000 | 60,000 | 130,000 | 33,000 | 1,060,000 | 504,000 | 1,564,000 | 25.5 | 15.4 | 40.9 |
| Engineering | | | | | | | | | | | | | | | | | |
| Topographic mapping | - | 202,000(2) | - | 300,000(2) | - | 123,000(2) | - | 114,000(2) | - | - | - | - | - | 739,000(2) | 739,000(2) | - | 4.0 | 4.0 |
| Surveys | - | - | 22,000(3) | - | 153,000(3) | - | 140,000(3) | - | 20,000 | - | - | - | 335,000(3) | - | 335,000 | 3.1 | - | 3.1 |
| Drilling and testing | - | - | 20,000 | 40,000 | 184,000 | 40,000 | 150,000 | 40,000 | 80,000 | 10,000 | 70,000 | - | 504,000 | 130,000 | 634,000 | 6.5 | 6.7 | 13.2 |
| Foundation design | 2,000 | 1,000 | 6,000 | 16,000 | 100,000 | 70,000 | 80,000 | 70,000 | 80,000 | 70,000 | 77,000 | - | 345,000 | 227,000 | 572,000 | 12.4 | 8.6 | 21.0 |
| Geology | 2,000 | 2,000 | 4,000 | 22,000 | 16,000 | 22,000 | 13,000 | 22,000 | 13,000 | 11,000 | 10,000 | - | 58,000 | 79,000 | 137,000 | 1.5 | 2.6 | 4.1 |
| Structural design | 1,000 | 1,000 | 13,000 | 15,000 | 40,000 | 65,000 | 40,000 | 75,000 | 40,000 | 70,000 | 13,000 | 15,000 | 147,000 | 241,000 | 388,000 | 5.2 | 8.9 | 14.1 |
| Real estate | - | - | 3,000 | 3,000 | 25,000 | 5,000 | 26,000 | 5,000 | 36,000 | 5,000 | - | - | 90,000 | 18,000 | 108,000 | 2.7 | 0.5 | 3.2 |
| Cost estimates | - | - | 4,000 | 6,000 | 7,000 | 15,000 | 15,000 | 24,000 | 15,000 | 20,000 | 5,000 | 10,000 | 46,000 | 75,000 | 121,000 | 1.7 | 3.5 | 5.2 |
| Drafting | 1,000 | 1,000 | 2,000 | 4,000 | 2,000 | 4,000 | 8,000 | 15,000 | 8,000 | 15,000 | 4,000 | 8,000 | 25,000 | 47,000 | 72,000 | 1.5 | 2.5 | 4.0 |
| Coordination and report preparation | 3,000 | 2,000 | 18,000 | 16,000 | 18,000 | 18,000 | 16,000 | 18,000 | 18,000 | 18,000 | 19,000 | 12,000 | 94,000 | 84,000 | 178,000 | - | - | - |
| Total | 9,000 | 209,000 | 92,000 | 422,000 | 545,000 | 362,000 | 490,000 | 383,000 | 310,000 | 219,000 | 198,000 | 45,000 | 1,644,000 | 1,640,000 | 3,284,000 | 34.6 | 37.3 | 71.9 |
| Environmental | | | | | | | | | | | | | | | | | |
| Biological | 2,000 | 5,000 | 17,000(4) | 23,000 | 17,000(4) | 23,000 | 17,000(4) | 23,000 | 17,300 | 23,000 | 10,000 | 13,000 | 80,000(4) | 110,000 | 190,000(4) | 2.6 | 4.1 | 6.7 |
| Cultural | 2,000 | 1,000 | 15,000(4) | 4,000 | 136,000(4) | 4,000 | 95,000(4) | 4,000 | 10,000 | 4,000 | 6,000 | 1,000 | 264,000(4) | 18,000 | 282,000(4) | 2.3 | 0.6 | 2.9 |
| Recreation | 1,000 | 1,000 | 5,000 | 7,000 | 47,000 | 8,000 | 44,000 | 7,000 | 47,000 | 5,000 | 26,000 | 2,000 | 170,000 | 30,000 | 200,000 | 6.4 | 1.0 | 7.4 |
| Social | 5,000 | 1,000 | 20,000(5) | 2,000 | 28,000(5) | 2,000 | 27,000 | 3,000 | 26,000 | 2,000 | 18,000 | 2,000 | 124,000(5) | 12,000 | 136,000(5) | 2.9 | 0.4 | 3.3 |
| Coordination and preparation of EIS | 1,000 | 1,000 | 5,000 | 7,000 | 21,000 | 8,000 | 42,000 | 13,000 | 51,000 | 17,000 | 30,000 | 10,000 | 150,000 | 56,000 | 206,000 | - | - | - |
| Total | 11,000 | 9,000 | 62,000 | 43,000 | 249,000 | 45,000 | 225,000 | 50,000 | 151,000 | 51,000 | 90,000 | 28,000 | 788,000 | 226,000 | 1,014,000 | 14.2 | 6.1 | 20.3 |
| Erosion and Sedimentation | | | | | | | | | | | | | | | | | |
| Land use | - | 2,000 | - | 25,000 | - | 25,000 | - | 20,000 | - | 20,000 | - | - | - | 92,000 | 92,000 | - | 2.4 | 2.4 |
| Program development | - | 1,000 | - | 5,000 | - | 10,000 | - | 10,000 | - | 22,000 | - | - | - | 48,000 | 48,000 | - | 1.3 | 1.3 |
| Total | - | 3,000 | - | 30,000 | - | 35,000 | - | 30,000 | - | 42,000 | - | - | - | 140,000 | 140,000 | - | 3.7 | 3.7 |
| Fish and Wildlife (agreement between Corps and Fish and Wildlife Service) | 4,000 | - | 10,000 | - | 14,000 | - | 7,000 | - | 5,000 | - | - | - | 40,000(6) | - | 40,000(6) | - | - | - |
| Total | 70,000 | 272,000 | 400,000 | 694,000 | 1,268,000 | 735,000 | 1,086,000 | 750,000 | 817,000 | 524,000 | 534,000 | 223,000 | 4,175,000 | 3,198,000 | 7,373,000 | 88.8 | 78.5 | 167.3 |

(1) Includes water quality contract, total $74,000 (Corps).
(2) Contracts (SCS), total $739,000.
(3) Includes survey contracts. Total $260,000 (Corps).
(4) Includes contracts. Total of $216,000 (Corps).
(5) Includes contracts. Total of $49,000 (Corps).
(6) Agreements with Fish and Wildlife Service, total $40,000 (Corps).

STAGE I — POS

STAGE II — Preliminary report and environmental assessment

Alternatives report (1 Oct 78)

(1 Oct 79)

Feasibility report and EIS

STAGE III

(1 Oct 85)

Study cost estimates and manpower requirements (based on annual projection of available manpower)

| | Fiscal year | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | 1984 | | 1985 | | | | | |
| | Corps | SCS | Corps | SCS | Corps | SCS | Corps | SCS | Corps | SCS | Corps | SCS | Corps | SCS | Corps | SCS | Corps | | | |
| [illegible] | $1,000 | $1,000 | $5,000 | $5,000 | $7,000 | $7,000 | $7,000 | $7,000 | $7,000 | $7,000 | $7,000 | $7,000 | $7,000 | $7,000 | $10,000 | $10,000 | $[illegible],000 | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | | | | | | | | | | | | | |
| [illegible] | 1,000 | 1,000 | 22,000 | 44,000 | 26,000 | 44,000 | 26,000 | 23,000 | 17,000 | 23,000 | 10,000 | 23,000 | 7,000 | 23,000 | 7,000 | 24,000 | 116,000 | [illegible] | 325,000 | 3.2 | 6.0 | 9.2 |
| [illegible] | 1,000 | 1,000 | 20,000 | 20,000 | 28,000 | 24,000 | 34,000 | 28,000 | 31,000 | 24,000 | 30,000 | 28,000 | 34,000 | 28,000 | 28,000 | 30,000 | [illegible],000 | [illegible] | 369,000 | 6.0 | 5.2 | 11.2 |
| [illegible] | 21,000 | 14,000 | 20,000 | 20,000 | 20,000 | 17,000 | 20,000 | 17,000 | 20,000 | 14,000 | 20,000 | 17,000 | 20,000 | 17,000 | 16,000 | 19,000 | [illegible],000 | [illegible] | 251,000 | 4.0 | 3.5 | 7.5 |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | 1,000 | 1,000 | 18,000 | 15,000 | 18,000 | 17,000 | 18,000 | 14,000 | 18,000 | 13,000 | 16,000 | 13,000 | 18,000 | 14,000 | 9,000 | 13,000 | [illegible],000 | [illegible] | 220,000 | - | - | - |
| [illegible] | 23,000 | 17,000 | 80,000 | 99,000 | 92,000 | 102,000 | 98,000 | 82,000 | 86,000 | 74,000 | 76,000 | 81,000 | 77,000 | 82,000 | 60,000 | 88,000 | [illegible],000 | [illegible] | [illegible],000 | 13.2 | 14.7 | 27.9 |
| [illegible] | | | | | | | | | | | | | | | | | | | | | | |
| [illegible] | [illegible] | [illegible] | 21,000 | 50,000 | 23,000 | 40,000 | 21,000 | 40,000 | 17,000 | 40,000 | 17,000 | 37,000 | 6,000 | 37,000 | 6,000 | 36,000 | 116,000 | [illegible] | 407,000 | 3.3 | 10.0 | 13.3 |
| [illegible] | [illegible] | [illegible] | 76,000 | 30,000 | 82,000 | 27,000 | 76,000 | 27,000 | 61,000 | 27,000 | 61,000 | 11,000 | 27,000 | 5,000 | 27,000 | 5,000 | 415,000 | [illegible] | 550,000 | 13.7 | 4.9 | 28.6 |
| [illegible] | [illegible] | [illegible] | 41,000 | 5,000 | 73,000 | 5,000 | 87,000 | 5,000 | 69,000 | - | 69,000 | 5,000 | 26,000 | - | 22,000 | 5,000 | 395,000 | [illegible] | 423,000 | 8.5 | 0.5 | 9.0 |
| [illegible] | [illegible] | [illegible] | 13,000 | 10,000 | 26,000 | 6,000 | 26,000 | 6,000 | 23,000 | 6,000 | 23,000 | 6,000 | 10,000 | 6,000 | 9,000 | 6,000 | 134,000 | [illegible] | 180,000 | - | - | - |
| preparation | | | | | | | | | | | | | | | | | | | | | | |
| Total | [illegible] | [illegible] | 151,000 | 95,000 | 204,000 | 78,000 | 210,000 | 78,000 | 170,000 | 73,000 | 170,000 | 59,000 | 68,000 | 48,000 | 64,000 | 52,000 | 1,060,000 | [illegible] | 1,564,000 | 25.5 | 15.4 | 40.9 |
| Engineering | | | | | | | | | | | | | | | | | | | | | | |
| Topographic mapping | - | 702,000[2] | - | 300,000[2] | - | 123,000[2] | - | 116,000[2] | - | - | - | - | - | - | - | - | - | 739,000[2] | 739,000[2] | - | 4.0 | 4.0 |
| Survey | - | - | 22,000[3] | - | 150,000 | - | 130,000[3] | - | 15,000 | - | 11,000 | - | 7,000 | - | - | - | 335,000[3] | - | 335,000[3] | 3.1 | - | 3.1 |
| Drilling and testing | - | - | 0 | 10,000 | 159,000 | 30,000 | 106,000 | 30,000 | 106,000 | 30,000 | 100,000 | 20,000 | 54,000 | 10,000 | 0 | - | 504,000 | 130,000 | 634,000 | 6.5 | 6.7 | 13.2 |
| Foundation design | 2,000 | 1,000 | 20,000 | 16,000 | 50,000 | 36,000 | 60,000 | 36,000 | 60,000 | 36,000 | 60,000 | 36,000 | 50,000 | 36,000 | 43,000 | 30,000 | 345,000 | 227,000 | 572,000 | 12.4 | 8.6 | 21.0 |
| Geology | 2,000 | 2,000 | 10,000 | 22,000 | 12,000 | 12,000 | 12,000 | 12,000 | 6,000 | 9,000 | 6,000 | 9,000 | 6,000 | 9,000 | 4,000 | 4,000 | 58,000 | 79,000 | 137,000 | 1.5 | 2.6 | 4.1 |
| Structural design | 1,000 | 1,000 | 13,000 | 15,000 | 14,000 | 16,000 | 14,000 | 27,000 | 14,000 | 54,000 | 35,000 | 54,000 | 28,000 | 54,000 | 28,000 | 28,000 | 147,000 | 241,000 | 388,000 | 5.2 | 8.9 | 14.1 |
| Real estate | - | - | 3,000 | 3,000 | 17,000 | 2,000 | 17,000 | 3,000 | 17,000 | 3,000 | 17,000 | 3,000 | 10,000 | 3,000 | - | 1,000 | 90,000 | 18,000 | 108,000 | 2.7 | 0.5 | 3.2 |
| Cost estimates | - | - | 4,000 | 6,000 | 7,000 | 11,000 | 8,000 | 11,000 | 8,000 | 15,000 | 8,000 | 11,000 | 28,000 | 11,000 | - | 10,000 | 46,000 | 75,000 | 121,000 | 1.7 | 3.5 | 5.2 |
| Drafting | 1,000 | 1,000 | 2,000 | 4,000 | 2,000 | 3,000 | 3,000 | 3,000 | 6,000 | 6,000 | 3,000 | 9,000 | 6,000 | 9,000 | 2,000 | 12,000 | 25,000 | 47,000 | 72,000 | 1.5 | 2.5 | 4.0 |
| Coordination and report preparation | 3,000 | 2,000 | 18,000 | 16,000 | 18,000 | 10,000 | 18,000 | 10,000 | 12,000 | 12,000 | 18,000 | 12,000 | 7,000 | 11,000 | 6,000 | 11,000 | 94,000 | 84,000 | 178,000 | - | - | - |
| Total | 9,000 | 209,000 | 92,000 | 392,000 | 420,000 | 243,000 | 362,000 | 246,000 | 238,000 | 165,000 | 252,000 | 154,000 | 188,000 | 143,000 | 83,000 | 88,000 | 1,844,000 | 1,640,000 | 3,284,000 | 34.6 | 37.3 | 71.9 |
| Environmental | | | | | | | | | | | | | | | | | | | | | | |
| Biological | 2,000 | 5,000 | 17,000 | 23,000 | 17,000[4] | 13,000 | 15,000[4] | 13,000 | 10,000 | 13,000 | 7,000 | 13,000 | 7,000 | 13,000 | 5,000 | 17,000 | 80,000 | 110,000 | 190,000[4] | 2.6 | 4.1 | 6.7 |
| Cultural | 2,000 | 1,000 | 15,000[4] | 4,000 | 151,000[4] | 3,000 | 70,000[4] | 2,000 | 8,000 | 2,000 | 8,000 | 3,000 | 6,000 | 3,000 | 4,000 | - | 264,000[4] | 17,000 | 281,000[4] | 2.3 | 0.6 | 2.9 |
| Recreation | 1,000 | 1,000 | 5,000 | 7,000 | 15,000 | 3,000 | 38,000 | 3,000 | 38,000 | 5,000 | 29,000 | 5,000 | 29,000 | 3,000 | 15,000 | 3,000 | 170,000 | 30,000 | [illegible],000[4] | 6.4 | 1.0 | 7.4 |
| Social | 5,000 | 1,000 | 20,000[5] | 2,000 | 24,000[5] | 2,000 | 40,000[5] | 2,000 | 15,000 | 2,000 | 11,000 | 2,000 | 7,000 | 1,000 | 2,000 | - | [illegible],000[5] | 12,000 | [illegible],000[4] | 2.9 | 0.4 | 3.3 |
| Coordination and preparation of EIS | 1,000 | 1,000 | 5,000 | 7,000 | 7,000 | 8,000 | 10,000 | 8,000 | 35,000 | 8,000 | 30,000 | 8,000 | 22,000 | 8,000 | 20,000 | 8,000 | 150,000 | 96,000 | [illegible],000 | - | - | - |
| Total | 11,000 | 9,000 | 62,000 | 43,000 | 214,000 | 29,000 | 193,000 | 28,000 | 106,000 | 30,000 | 85,000 | 31,000 | 71,000 | 28,000 | 46,000 | 28,000 | [illegible],000 | 265,000 | 1,014,000 | 14.2 | 6.1 | 20.3 |
| Erosion and Sedimentation | | | | | | | | | | | | | | | | | | | | | | |
| Land use | - | 2,000 | - | 25,000 | - | 15,000 | - | 12,000 | - | 8,000 | - | 8,000 | - | 8,000 | - | 14,000 | - | 92,000 | 92,000 | - | [illegible] | [illegible] |
| Project development | - | 1,000 | - | 5,000 | - | 4,000 | - | 4,000 | - | 7,000 | - | 7,000 | - | 10,000 | - | 10,000 | - | 48,000 | 48,000 | - | 1.3 | 1.3 |
| Total | - | 3,000 | - | 30,000 | - | 19,000 | - | 16,000 | - | 15,000 | - | 15,000 | - | 18,000 | - | 24,000 | - | 140,000 | 140,000 | - | 3.7 | 3.7 |
| Fish and Wildlife (agreement with Corps) | 4,000 | - | 10,000 | - | 8,000 | - | 6,000 | - | 4,000 | - | 3,000 | - | 3,000 | - | 2,000 | - | [illegible],000[6] | - | [illegible],000[4] | - | - | - |
| Total | [illegible] | [illegible] | 400,000 | 664,000 | 945,000 | 478,000 | 876,000 | 457,000 | 611,000 | 364,000 | 593,000 | 347,000 | 328,000 | 326,000 | 265,000 | 290,000 | 4,175,000 | 3,108 | 7,373,000 | 88.8 | 78.5 | 167.3 |

(1) [illegible] specific contracts, total [illegible],000 (Corps).
(2) Contracts (SCS), total $733,000.
(3) Includes survey contract, total $260,000 (Corps).
(4) Includes contracts, total of $216,000 (Corps).
(5) Includes contracts, total of $40,000 (Corps).
(6) Agreements with Fish and Wildlife Service, total $40,000 (Corps).

Summary of manpower requirements for study conditions displayed in the tables on pages 176, 177, and 178

| Major work item | Condition[1] | Man-years required: 1979 Corps | 1979 SCS | 1980 Corps | 1980 SCS | 1981 Corps | 1981 SCS | 1982 Corps | 1982 SCS | 1983 Corps | 1983 SCS | 1984 Corps | 1984 SCS | 1985 Corps | 1985 SCS | Total Corps | Total SCS | Combined |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Public involvement | 1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | - | - | - | - | 1.3 | 1.3 | 2.6 |
| | 2 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | - | - | | - | 1.3 | 1.3 | 2.6 |
| | 3 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 1.3 | 1.3 | 2.6 |
| Planning and study management | 1 | 2.2 | 2.9 | 3.0 | 3.2 | 2.8 | 3.2 | 3.2 | 3.5 | 2.0 | 1.9 | - | - | - | - | 13.2 | 14.7 | 27.9 |
| | 2 | 1.8 | 2.5 | 3.0 | 3.2 | 2.8 | 3.2 | 3.2 | 3.5 | 2.4 | 2.3 | - | - | - | - | 13.2 | 14.7 | 27.9 |
| | 3 | 1.8 | 2.5 | 2.1 | 2.5 | 2.3 | 2.0 | 2.0 | 1.8 | 1.8 | 1.9 | 1.8 | 2.0 | 1.4 | 2.0 | 13.2 | 14.7 | 27.9 |
| Hydrology and hydraulics | 1 | 7.2 | 5.0 | 8.2 | 5.0 | 5.2 | 3.0 | 3.3 | 1.5 | 1.6 | 0.9 | - | - | - | - | 25.5 | 15.4 | 40.9 |
| | 2 | 4.0 | 2.6 | 8.2 | 5.0 | 5.3 | 4.8 | 4.4 | 2.1 | 3.6 | 0.9 | - | - | - | - | 25.5 | 15.4 | 40.9 |
| | 3 | 4.0 | 2.6 | 5.0 | 2.6 | 5.0 | 2.6 | 4.0 | 2.5 | 4.0 | 1.9 | 1.8 | 1.6 | 1.7 | 1.6 | 25.5 | 15.4 | 40.9 |
| Engineering | 1 | 5.4 | 5.9 | 7.5 | 10.2 | 9.5 | 11.5 | 8.2 | 8.1 | 4.0 | 1.6 | - | - | - | - | 34.6 | 37.3 | 71.9 |
| | 2 | 2.4 | 5.9 | 9.8 | 10.2 | 10.1 | 11.5 | 8.5 | 8.1 | 3.8 | 1.6 | - | - | - | - | 34.6 | 37.3 | 71.9 |
| | 3 | 1.9 | 4.3 | 6.4 | 6.0 | 6.5 | 6.5 | 5.5 | 6.5 | 6.0 | 5.9 | 5.4 | 5.1 | 2.9 | 3.0 | 34.6 | 37.3 | 71.9 |
| Environmental | 1 | 3.7 | 1.3 | 3.6 | 1.4 | 2.8 | 1.4 | 2.6 | 1.4 | 1.5 | 0.6 | - | - | - | - | 14.2 | 6.1 | 20.3 |
| | 2 | 1.3 | 0.8 | 3.6 | 1.4 | 3.4 | 1.4 | 3.6 | 1.4 | 2.3 | 1.1 | - | - | - | - | 14.2 | 6.1 | 20.3 |
| | 3 | 1.3 | 0.8 | 1.7 | 0.9 | 3.0 | 0.9 | 3.1 | 1.0 | 2.2 | 0.9 | 1.9 | 0.8 | 1.0 | 0.8 | 14.2 | 6.1 | 20.3 |
| Erosion and sedimentation | 1 | - | 0.8 | - | 1.0 | - | 0.8 | - | 1.1 | - | - | - | - | - | - | - | 3.7 | 3.7 |
| | 2 | - | 0.8 | - | 1.0 | - | 0.8 | - | 1.1 | - | - | - | - | - | - | - | 3.7 | 3.7 |
| | 3 | - | 0.8 | - | 0.5 | - | 0.4 | - | 0.4 | - | 0.4 | - | 0.5 | - | 0.7 | - | 3.7 | 3.7 |
| Totals | 1 | 18.6 | 16.0 | 22.6 | 21.1 | 20.6 | 20.2 | 17.6 | 15.9 | 9.4 | 5.3 | - | - | - | - | 88.8 | 78.5 | 167.3 |
| | 2 | 9.6 | 12.7 | 24.9 | 21.1 | 21.9 | 22.0 | 20.0 | 16.5 | 12.4 | 6.2 | - | - | - | - | 88.8 | 78.5 | 167.3 |
| | 3 | 9.1 | 11.1 | 15.4 | 12.7 | 17.0 | 12.6 | 14.8 | 12.4 | 14.2 | 11.2 | 11.1 | 10.2 | 7.2 | 8.3 | 88.8 | 78.5 | 167.3 |

(1) Condition 1 - see table on page 176.
Condition 2 - see table on page 177.
Condition 3 - see table on page 178.

## RECOMMENDATION

**(To be added in final reconnaissance report.)**

HARRY M. MAJOR
State Conservationist
Soil Conservation Service

FORREST T. GAY, III
Colonel, Corps of Engineers
District Engineer

UPPER MISSISSIPPI RIVER SUBBASIN
STUDY (PUBLIC LAW 87-639)

RECONNAISSANCE STAGE REPORT
(PLAN OF STUDY)

APPENDIX A

U.S. FISH AND WILDLIFE SERVICE
PLANNING AID LETTERS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
AND
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS

APPENDIX A

U.S. FISH AND WILDLIFE SERVICE
PLANNING AID LETTERS

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# United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

St. Paul Field Office
538 Federal Building and U.S. Court House
316 North Robert Street
St. Paul, Minnesota 55101

Colonel Forrest T. Gay, III
District Engineer
U. S. Army Corps of Engineers
St. Paul District
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

12 APR 1978

Dear Colonel Gay:

This letter pertains to the U.S. Fish and Wildlife Service's scope of work for the P.L. 87-639 Joint Study in the Upper Mississippi River Subbasin between the Corps of Engineers and the Soil Conservation Service.

It is the basic policy of the Fish and Wildlife Service to participate fully in all phases of the national water and related land development program, including those projects Federally permitted or assisted. The Fish and Wildlife Service insists that projects be planned, formulated, and implemented with full consideration for the protection, restoration and enhancement of fish and wildlife resources. Fish and Wildlife related values are public in nature. They are held in trust and managed for the people of the States and Nation by State and Federal Governments. Direction, authority and guidelines for involvement of the Fish and Wildlife Service and other Federal agencies in the protection of fish and wildlife resource values in connection with water resources development is provided in the following legislation:

1. Federal Water Project Recreation Act (16 U.S.C. 460l-12-460l-21; 79 Stat 213), as amended,

2. Rivers and Harbors Act of 1899 (33 U.S.C. 401 et seq; 30 Stat. 1151), as amended and supplemented,

3. Rivers and Harbors Act of June 20, 1899 (33 U.S.C. 401 et seq; 30 Stat. 1151), as amended and supplemented,

4. National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347; 83 Stat. 852),

5. Watershed Protection and Flood Prevention Act, (16 U.S.C. 1001-1009; 33 U.S.C. 7016; 68 Stat. 666), as amended,

6. Executive Order 11988 Floodplain Management,

7. Executive Order 11990 Protection of Wetlands, and the

8. Fish and Wildlife Coordination Act (16 U.S.C. 661-666cc; 48 Stat. 401), as amended.

The intent of the legislation indicated above is best summarized by the purpose of the Fish and Wildlife Coordination Act, Section 661, to recognize "the vital contribution of our wildlife resources to the Nation, the increased public interest and significance thereof due to expansion of our National economy and other factors, and to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs."

The Fish and Wildlife Service's responsibility for conserving the nation's natural resources insures that the Service will cooperate fully in planning for water and related land development projects to insure that the proposals:

1. are environmentally sound,
2. minimize harmful effects on fish and wildlife, their habitat and their uses, and
3. maximize enhancements of their resources and uses.

The Service's expertise will be made available through identifying and evaluating the resources affected in any given planning situation and through the evaluation of probable impacts of alternative developments on the resources. The probable impacts will be evaluated in terms of non-monetary measures of changes in quality and productivity of fish and wildlife habitat. The same measurements will form a basis and justification for recommending means to (a) prevent losses, (b) mitigate damages and/or (c) compensate for losses of habitat. The Fish and Wildlife Service's habitat evaluation procedures will be used to analyze terrestrial and aquatic habitat in the project area. This planning process will serve as a basis for multi-objective planning as called for in Principles and Standards. To implement this planning process the materials and data indicated below must be provided;

1. Current planning area maps and Color Infared aerial photo mosaics for evaluation and planning purposes. The scale of the aerial photograph mosaics must be equal to or greater than 4" to the mile. Aerial photo mosaics are necessary for areas affected directly and indirectly and for lands potentially to be considered for mitigation or compensation of adverse effects.

2. Land-use, economic and population information projections "without-a-project" based on reliable identified studies.

3. Data showing expected project-caused or induced changes in land and water use for the project area affected over the full planning period by selected target years and

4. Documentation of physical land resources (soil stability) and geological resources, culturally significant resources, areas of natural beauty, historical and archeological amenities, documented ecological resources and species threatened with extinction).

Please keep us abreast of your planning efforts.

Sincerely yours,

Richard F. Berry

Field Supervisor

cc: Mr. Harry M. Major
Soil Conservation Service
U.S. Department of Agriculture
200 U.S. Court House & Federal Building
316 North Robert Street
St. Paul, Minnesota 55101

# United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

St. Paul Field Office, Ecological Services
538 Federal Building and U.S. Court House
316 North Robert Street
St. Paul, Minnesota 55101

Colonel Forrest T. Gay, III
District Engineer
U.S. Army Corps of Engineers
St. Paul District
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Gay:

This letter is provided to document U.S. Fish and Wildlife Service involvement in Stage I of The Upper Minnesota River Subbasin Implementation Study conducted by the Department of the Army and the Department of Agriculture as authorized by Congress under Public Law 87-639. The primary objective of this study is to further investigate and clarify alternatives for orderly development of water and related land resources of the study area to solve the flooding problems.

The estimated overall length of the study is 5 years with Stage I, Developing a Plan of Study, to be completed in FY 1978. During this Stage the Fish and Wildlife Service has been involved in the following areas of Plan of Study Development:

1. A representative of the U.S. Fish and Wildlife Service is a member of the Advisory Committee for the Implementation Study and the Fish and Wildlife Service has been represented at quarterly meetings held throughout FY 1978.

2. The U.S. Fish and Wildlife Service is represented on the Environmental Resources Work Group for the Implementation Study. This group developed needed Fish and Wildlife Investigations for project compliance with the intent of the National Environmental Policy Act of 1969 and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.)

In addition to the above, our letter of April 12, 1978 identified Fish and Wildlife Service interest and advised the Soil Conservation Service and the Corps of Engineers of guidelines and constraints that must be considered when investigating objectives addressed in the Plan of Study.

The draft preliminary Plan of Study developed by the Soil Conservation Service and the Corps of Engineers was reviewed and our review comments were submitted on May 26, 1978. These letters indicated our concerns with project planning and its emphasis on structural measures to solve flooding problems. It is the view of the FWS that nonstructural measures should be given equal consideration, especially in instances where fish and wildlife resources may be affected. In reviewing the POS several needs to improve fish and wildlife resources were indicated as being of concern to the Fish and Wildlife Service.

The most important of these are:

1. The need to preserve the remaining cold water streams in South Dakota and Minnesota that provide habitat for brook and brown trout.

2. The need to preserve wetland habitat in this prairie pothold region for use of waterfowl and other wildlife species.

3. The need to encourage private landowners to retain and improve their woodlots and windbreaks and to manage woodlands for their wildlife habitat values.

4. The need for improving wildlife habitat in the areas of agricultural productivity through implementation of programs emphasizing land treatment practices such as crop rotations, minimum tillage, critical area planting, farmstead and field management, woodland management, pasture management, and delayed mowing of herbaceous cover until after nesting season.

The involvement indicated above complies with the intent of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) which requires agencies to coordinate with the Department of Interior through the Fish and Wildlife Service to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water resource development programs.

In subsequent stages of the POS, Stages II and III planned for FY 1979 - FY 1982, the Fish and Wildlife Service will participate in planning to insure that final project plans:

1. are environmentally sound,
2. minimize harmful effect on fish and wildlife and their habitat and,
3. maximize enhancement of fish and wildlife resources and their use.

Please keep us abreast of your planning efforts.

Sincerely,

Richard F. Berry

Richard F. Berry
Field Office Supervisor

cc: MN DNR, St. Paul, MN
SCS, St. Paul, MN
USFWS, Pierre, S. Dakota
Attn: Philip Laumeyer

[illegible] RIVER BASIN
STUDY (PUBLIC LAW 83-566)
RECONNAISSANCE STAGE REPORT
(PLAN OF STUDY)

# APPENDIX B

## LETTERS OF ASSURANCE AND COORDINATION

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
AND
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS

APPENDIX B

LETTERS OF ASSURANCE AND COORDINATION

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DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

DEPARTMENT OF AGRICULTURE
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

NCSED-PB

13 April 1978

Mr. George Alexander, Jr.
Regional Administrator, Region V
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Alexander:

This is to advise you of a current Upper Minnesota River Subbasin Implementation Study being conducted jointly by the Soil Conservation Service and the Corps of Engineers under the authorization of Public Law 87-639. The inclosed preliminary draft plan of study provides an overview of the investigation. This preliminary draft is being reviewed by local study participants for comment on scope and content, particularly detailed studies, work schedule and costs. The preliminary draft will be modified to reflect their comments and mailed out as a draft plan of study at a later time for Federal, State and local agency review and comment.

The Soil Conservation Service and Corps of Engineers would like to meet with representatives of the U.S. Environmental Protection Agency, Minnesota Pollution Control Agency, and South Dakota Department of Environmental Protection to discuss specific water quality issues associated with the ultimate implementation of a selected water and land resource development plan to achieve the study objectives listed on page 2 of the plan of study.

Specific issues and questions we would like to address include:

a. Existing water quality standards for the subbasin tributaries. Do the tributaries now meet these standards? What water quality standards will the State establish for the reservoir and the stream reaches downstream of a dam? If water quality standards are not currently met for the basin tributaries, do you expect full compliance with standards after reservoir development?

b. Do you have any specific concerns regarding the impacts of potential channel modifications on the assimilative capacity of streams? What parameters are of concern? Is any sampling, monitoring or modeling needed to determine

the water quality impacts of potential channel modifications? If needed, what specific studies do you require and what level of detail is acceptable to your agency?

c. What do the State agencies view as beneficial uses of the basin tributaries? Is reservoir development compatible with these beneficial uses? Is stream channelization development compatible with these beneficial uses? Is the elimination of cross-subbasin flow compatible with these beneficial uses? Are high and low flow diversion channel developments compatible with these beneficial uses? If any of these types of development result in violation of existing water quality standards of the tributaries, under what circumstances and conditions would the Environmental Protection Agency accept the State agency's:

(1) Variances in the water quality standards for parameters within a specific use classification?

(2) Changes in the use classification for a segment of the stream?

(3) Changes in the use classification for the entire stream?

d. Would dry dam flood control reservoir type impoundments with short-term detention times be considered to impose any significant downstream water quality problems? What minimum detention time would be considered sufficient to potentially impact on downstream water quality?

e. Would anticipated eutrophication of a reservoir development result in unequivocal opposition of the Environmental Protection Agency to that project?

f. Under what conditions, if any, would beneficial impacts of flood control, water quality, recreation, and fish and wildlife be sufficient to alter opposition of the Environmental Protection Agency and State agencies to the potential developments not fully complying with their water quality standards?

g. Would current state-of-the-art methods of mitigation or elimination of potential water problems downstream of a reservoir such as a multi-level outlet structure, aeration of the reservoir to prevent thermal stratification, or any other methods and coordination of the reservoir operation plan be acceptable?

h. The water quality monitoring program including the required parameters and frequency and duration of data collection. What physical, chemical, and biological parameters are used to determine whether a reservoir, channel modification or diversion is acceptable and meets the beneficial uses of a river?

i. A discussion of any predictive models that should be included in the water quality studies to evaluate the parameters.

NCSED-PB 13 April 1975
Mr. George Alexander, Jr.

j. Specific items that should be included in the water quality report. What constitutes an adequate report and documentation?

k. At what phases of project planning should (1) preliminary water quality evaluation be made and reported based on available data and (2) detailed water quality data collection and analysis be conducted and reflected in the planning process and environmental impact statement?

l. Any other related matters as deemed appropriate.

We expect that a 1-day meeting will be required to adequately address all of the above items. Accordingly, we have scheduled a meeting in room 1220 of the Corps of Engineers office for 9 a.m. on 24 April 1975. We are arranging a field trip following the meeting to commence that day or the following morning and run through Thursday, 27 April, with return to St. Paul on Friday, 28 April. We invite you to participate and will arrange transportation needs. Please confirm the number of representatives from your office who will participate in the field trip with either Mr. Peter Fischer, Chief, Hydraulic Engineering & Foundation Materials Branch (612-725-7567), or Mr. Robert Northrup, Chief, General Investigations Section (612-725-7559).

Sincerely,

1 Incl
As stated

HARRY H. MAJOR
State Conservationist
Soil Conservation Service

FORREST T. GAY, III
Colonel, Corps of Engineers
District Engineer

Copy furnished:
Mr. Keith L. Beseke
Western District Office
U.S. Environmental Protection Agency
7401 Lyndale Avenue South
Minneapolis, Minnesota 55423

Identical letters to:
(See attached list)

Identical letters to:

Ms. Sandra Gardebring
Executive Director
Minnesota Pollution Control Agency
1935 W. County Road B-2
Roseville, Minnesota 55113

Mr. John A. Green
Regional Administrator
Region VIII
U.S. Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dr. Robert H. Hayls
President
South Dakcta Department of Environmental
Protection
The State Capitol
Pierre, South Dakota 57501

Copy to: Mr. Jim Nelson
South Dakota Department of Environmental
Protection
Joe Foss Building
Pierre, South Dakota 57501

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

DEPARTMENT OF AGRICULTURE
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

NCSPP-PR

19 April 1978

Mr. George Alexander, Jr.
Regional Administrator, Region V
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Alexander:

This supplements our letter of 13 April 1978 concerning the Upper Minnesota River Subbasin Implementation Study being conducted under Public Law 87-6[illegible].

Inclosed is additional information and an itinerary for the tour of the subbasin scheduled for 24-27 April 1978. If you have any questions on this information or the tour, please contact us. Mr. Robert Northrup, Chief, General Investigations Section (612-725-7559) can provide additional details.

Sincerely,

1 Incl
As stated

HARRY H. MAJOR
State Conservationist
Soil Conservation Service

FORREST T. GAY, III
Colonel, Corps of Engineers
District Engineer

Copy furnished:
Mr. Keith L. Beseke
Western District Office
U.S. Environmental Protection Agency
7401 Lyndale Avenue South
Minneapolis, Minnesota 55423

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Roseville, Minnesota 55113

Mr. John A. Green
Regional Administrator
Region VIII
U.S. Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dr. Robert H. Hayls
President
South Dakota Department of Environmental
Protection
The State Capitol
Pierre, South Dakota 57501

Copy to:

Mr. Jim Nelson
Assistant Chief, Water Division
South Dakota Department of Environmental
Protection
Joe Foss Bldg.
Pierre, South Dakota 57501

UPPER MINNESOTA RIVER SUBBASIN IMPLEMENTATION PROJECT
CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE

WATER QUALITY ISSUES MEETING
AND
TOUR OF STUDY AREA

ITINERARY

| Date | *Tour Guide Host | Subject | Time and Place |
|---|---|---|---|
| Mon., 24 Apr 78 | | Coffee and rolls. | 8:30 a.m., PEDC Training room, 6th floor, Post Office Bldg., 180 E. Kellogg Blvd. |
| | | Study Area Water Quality Issues Meeting. | 9:00-12:00 a.m., PEDC Training room. |
| | | Board Tour bus, Enroute to Milbank, South Dakota. | 12:30-1:00 p.m., Front Post Post Office Building. |
| | | Confirm Motel Reservations, Milbank, South Dakota. | 5:30 p.m., at Lantern and Manor Motels. (both 605-432-4591) |
| | | Fellowship and Dinner joined by Messrs. Willard Pearson, Walter Matz, Lyle Hanson and Wives, representing the Area II Action Committee. | 6:00 p.m., at Lantern Motel Restaurant (605-432-9871) |
| Tues., 25 Apr 78 | Walter Matz & Odell Greene Jerry Siegel | Tour of Yellow Bank R. Basin, South Dakota and North Fork Lac Qui Parle River Basin, Minnesota. | 8:30 Board tour bus with luggage at motels. |
| | | 1. Visit Corps Big Stone Lake-Whetstone River Project South Dakota-Minnesota. | 12:00 picnic or box lunch arranged by Odell Greene |
| | | 2. Visit, via tractor and trailer, a crossover flooding breakout site between Yellow Bank and Lac Qui Parle Basin, & small and major reservoir sites on Yellow Bank River. | |
| | Willard Pearson | 3. Visit small & major reservoir sites & other points of interest along Lost Creek and West Branch North Fork Lac Qui Parle River. | |
| | | Confirm Motel reservations Montevideo, Minnesota. | 5:00 p.m., at Monti (269-8889) & Fiesta (269-8896) Motels. |
| | | Fellowship and Dinner Individual arrangement. | Restaurants near Motels. |

| Date | Tour Guide Host | Subject | Time & Place |
|---|---|---|---|
| Wed., 26 Apr 78 | Willard Pearson<br>Willis Beecher | Tour of North and South Fork Lac Qui Parle River Basins and Yellow Medicine River Basin.<br>1. Visit major reservoir site on Florida Creek, N. Fork Lac Qui Parle River.<br>2. Visit RC&D reservoir site on Lazarus Creek South Fork Lac Qui Parle River.<br>3. Visit PL 566 reservoir site on Conby Creek, South Fork Lac Qui Parle River.<br>4. Visit a crossover flooding breakout site between the Lac Qui Parle and Yellow Medicine River basins.<br>5. Visit major reservoir site on South Fork Lac Qui Parle River south of Conby.<br>6. Weber dam between Florida Creek and Lazarus Creek. | 8:30 Board tour bus with luggage at Motels.<br>12:00 Lunch at Restaurant. |
| | John Boulton | Tour of North and South Fork Yellow Medicine River.<br>1. Visit crossover flooding breakout site near Porter.<br>2. Visit small and major reservoir sites on North Fork Yellow Medicine near Hendricks, Minnesota.<br>3. Visit small and major reservoir sites on South Fork Yellow Medicine River. | 1:00 p.m. |
| Wed., 26 Apr 78 | John Boulton | Confirm Motel Reservations<br>Fellowship and Dinner Joined by Messrs. Willard Pearson and John Boulton.<br>Slide Presentation of Crossover Flooding in the Basins visited, Willard Pearson, John Boulton, Hal Burnham & Tom Hallbeck | 5:00 p.m. at Ramada Inn. Marshall, Minnesota<br>6:00 p.m. at Ramada Inn.<br>7:30 p.m. at Southwest State College, Marshall, Minnesota |
| Thurs., 27 Apr 78 | Hal Burnham,<br>Torgny Anderson<br>Roy Syverson | Tour of Redwood and Cotton-wood River Basins. | 8:30 Board tour bus. |

| Date | Tour Guide Host | Subject | Time and Place |
|---|---|---|---|
| Thurs. 27 Apr 78 | Hal Burnham<br>Torgny Anderson<br>Roy Syverson | 1. Visit major reservoir site below Lake Benton on Dead Coon Creek NW of Russell. | |
| | | 2. Visit major reservoir site downstream of wild-life area on Redwood River south of Russell. | |
| | | 3. Visit major reservoir forested site on Cotton-wood River. | |
| | | 4. Visit major reservoir site under construction with State funds administered by the S&WC Board at Walnut Grove. | |
| | | | 12:00 p.m., lunch at restaurant to be determined |
| | | Board tour bus Enroute to Minneapolis, St. Paul, Minnesota. | 4:00 p.m., New Ulm vicinity |
| | | Arrive Minneapolis, St. Paul, Minnesota Airport drop-off, if needed. | 6:30 p.m. |

* Tour Guide Hosts:

Walter Matz, Watershed Manager, Lac Qui Parle-Yellow Bank (LqP-YB) Watershed District

Odell Greene, District Conservationist, Milbank Field Office, 592 Federal Building, Milbank, South Dakota

Willard Pearson, President, LqP-YB Watershed District; Chairman, Area II Action Committee

Jerry Siegel, Manager, East Dakota Conservancy District; member Area II Action Committee

Lyle Hanson, Watershed Manager, LqP-YB Watershed District

Willis Beecher, Watershed Manager, LqP-YB Watershed District

John Boulton, President, Yellow Medicine River Watershed District; member of Area II Action Committee

Hal Burnham, Engineer, State Soil & Water Conservation Board, Ivanhoe, Minnesota

Tom Hallbeck, University of Minnesota Extension Service

Torgny Anderson, Retired Chairman Lyon County Board; Member of Area II Action Committee

Roy Syverson, Chairman, Redwood County Board; Member of Area II Action Committee

UPPER MINNESOTA RIVER SUBBASIN IMPLEMENTATION STUDY
CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE
TOUR OF STUDY AREA - 24-27 APRIL 1978

TOUR INFORMATION

1. A schedule for the water quality issues meeting and tour is attached.

2. Much effort has been made to insure that the tour will be as informative as possible. Local sponsors will serve as hosts.

3. Additional copies of the draft Plan of Study have been produced. Each participant will receive a personal copy. You may want to make notes in your copy. A packet of information is also being assembled for you.

4. About 25 to 35 persons are expected for the tour. A 48-passenger school bus will be used for transportation. Block reservations for lodging have been made for Monday, Tuesday, and Wednesday. Room rates are about $15 for Monday and Tuesday and $20 for Wednesday.

5. We will leave St. Paul about 1:00 p.m. on Monday, April 24 and arrive at Milbank, South Dakota, before a scheduled dinner at 6:00 p.m. No program is planned during the 4- to 5-hour trip. We encourage you to become acquainted with others on the tour (we are going to be rather close together for the week). You might like to bring a guitar, cards, reading materials, swimming suits, cameras, etc.

6. We will make a number of stops each day on the tour. Bring clothing suitable for outdoors; rain gear may be desirable. You may wish to walk over some of the areas visited (structure sites, overflow areas, etc.). Local land owners will point out damage areas, frequency of flooding, etc., along the tour route.

7. We will leave New Ulm at 4:00 p.m. on Thursday, April 27, for the return to St. Paul.

Attendance List
Study Area Tour, Tuesday, 25 April 1978

| Name | Address | Organization |
|---|---|---|
| Linda Lensing | Canby, MN | Secretary, Lac qui Parle-Yellow Bank Watershed District |
| Jerry F. Siegel | Brookings, SD | Manager, East Dakota Conservation Subdistrict |
| Willard Pearson | Dawson, MN | Lac qui Parle-Yellow Bank Watershed District |
| Walter Maatz | Bellingham, MN | Lac qui Parle-Yellow Bank Watershed District |
| Gloria Pearson | Dawson, MN | |
| Ellsworth Smogard | Madison, MN | State Representative, District 20A |
| Milford Anderson | La Bolt, SD | East Dakota Conservation Subdistrict |
| Lyle Hanson | Madison, MN | Lac qui Parle-Yellow Bank Watershed District |
| Glen Anderson | Bellingham, MN | State Representative, District 13B |
| Odell Greene | Milbank, SD | District Conservationist, Soil Conservation Service |
| Harley Svarvati | Milbank, SD | Technician, Soil Conservation Service |
| Norman Larson | Worthington, MN | Representing Representative Richard Nolan |
| Willie Beecher | Canby, MN | Lac qui Parle-Yellow Bank Watershed District |
| John J. Gundrison | Clarkfield, MN | District Conservationist, Soil Conservation Service |
| Kenneth Helgeson | | Yellow Medicine River Watershed |
| Ed Traen | Cottonwood, MN | Yellow Medicine River Watershed |
| Keith Roble | Marshall, MN | Engineer, Soil Conservation Service |
| Melvin J. Niehaus | Ivanhoe, MN | District Conservationist, Soil Conservation Service |
| John Boulton | Porter, MN | Yellow Medicine River Watershed |
| Vernon Maas | Canby, MN | City Administrator, Canby |
| Tom Fischer | Marshall, MN | Soil Conservation Service |
| Carl Hauschild | | Lincoln County Commission |
| George Holcomb | Marshall, MN | Agricultural Extension Service, Marshall State University |
| Tom Hallbeck | Marshall, MN | Agricultural Extension Service, Marshall State University |
| Hal Barnham | Ivanhoe, MN | |
| Jim Nichols | Lake Benton, MN | State Senator |

STATE PLANNING BUREAU
State Capitol
Pierre, South Dakota 57501
605/~~224-3661~~
773-3661

SOUTH Dakota Office of
Executive Management

April 28, 1978

Mr. Robert Northrup, Chief
General Investigation Section, Planning Board
U.S. Army Corp of Engineers
Post Office Building and Custom House
St. Paul, Minnesota 55101

Dear Mr. Northrup:

As I believe you are aware, Mr. Stan Kummer of your office has been scheduled to meet with the South Dakota Natural Resources Cabinet Subgroup on Wednesday, May 3, 1978, for the purpose of making a presentation regarding the purpose and status of the Upper Minnesota River Sub-Basin Implementation Project. The meeting will be held at 1:30 p.m. in the Game, Fish and Parks commission room, Sigrud Anderson State Office Building.

The Natural Resources Cabinet Subgroup is the forum through which major policy issues pertaining to natural resources are reviewed and coordinated. The Subgroup is chaired by Dr. Allyn Lockner, Secretary of the South Dakota Department of Environmental Protection. Other members of the Subgroup are the departments of Natural Resources Development, Game, Fish and Parks, Agriculture, Transportation and School and Public Lands. The Bureaus of Finance and Management and State Planning, as well as the Office of Energy Policy, also participate as Subgroup members.

A copy of the agenda for the May 3rd Subgroup meeting is enclosed for your reference. Please contact me if you should have any additional questions. We look forward to Mr. Kummer's presentation.

Cordially,

Scott D. McGregor
Deputy Commissioner

cc: Mr. Stan Kummer

STATE PLANNING BUREAU
State Capitol
Pierre, South Dakota 57501
605/224-3661

SOUTH Dakota Office of
Executive Management

April 28, 1978

MEMORANDUM

TO: Natural Resources Cabinet Subgroup

FROM: Scott D. McGregor

RE: Agenda for May 3, 1978, Subgroup Meeting

The next meeting of the Natural Resources Cabinet Subgroup will be held on Wednesday, May 3, 1978 at 1:30 p.m. in the Game, Fish and Parks Conference Room, Sigrud Anderson Office Building. Items to be considered at that time include:

1. WESTPO update (Lockner)
   a. State Management of Resource Scarcity and Hazards
   b. WESTPO Committee on Natural Resources

2. Upper Minnesota River Subbasin Implementation Project, P.L. 87-639 (Stan Kummer, Corps of Engineers)

3. Water Development Alternatives, Vol. II State Water Plan (Butler)

4. Natural Resources Organizational Study (Garry)

5. High Plains Project; develop recommendations for the Governor (Lockner)

6. Department of Energy and Utility Regulation; develop recommendations for the Governor (Lockner, Van Loan)

7. Garrison EIS; develop recommendations for the Governor (Lockner)

8. Mine Safety Inspections (Griffiths)

9. Other
   a.
   b.
   c.

SOUTH Dakota Department of
Environmental Protection
Pierre, South Dakota 57501
Phone (605) 224-3351

April 28, 1978

Don Hartman
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Don:

Due to prior commitments, no one from our Department was able to attend a tour of the proposed Upper Minnesota River Sub-basin Implementation Project sites in South Dakota. However, other departments in South Dakota in addition to our own should be involved with the project. The Governor's Natural Resources Sub-Cabinet can serve as a forum to meet and gain input from the concerned Departments. A mailing list of members is included. I would appreciate it if someone from the Corps of Engineers and the Soil Conservation Service familiar with the Preliminary Draft could come and give a presentation and answer questions on the project. Prior to the meeting it would be desirable if a brief paper summarizing the project could be given to the members to increase their participation. If arrangements can be made for such a meeting, please contact Ben Orsbon, Bureau of Planning, State Capitol, Pierre, South Dakota 57501, phone (605) 773-3661 and myself. Ben is in charge of the agenda for the Sub-Cabinet.

Sincerely,

Leland Baron

Leland Baron
Environmental Analyst III
Office of Water Quality

cc: Harry M. Major
State Conservationist
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

Forrest T. Gay, III
Colonel, Corps of Engineers
St. Paul District Engineer
11135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

A4/16

*Equal Opportunity Employer*

Natural Resources Sub-Cabinet

Allyn O. Lockner, Secretary (Chairman of Sub-Committee)
S.D. Department of Environmental Protection
Foss Building
Pierre, South Dakota 57501

Vern Butler, Secretary
Dept. of Natural Resource Development
Foss Building
Pierre, South Dakota 57501

Richard Garry, Commissioner
Bureau of Finance and Management
State Capitol
Pierre, South Dakota 57501

Albert Griffiths, Director
Division of Conservation
Anderson Building
Pierre, South Dakota 57501

George D. Kane, Commissioner
Department of School and Public Lands
State Capitol
Pierre, South Dakota 57501

Steve R. Merrick, Commissioner
Bureau of Planning
State Capitol
Pierre, South Dakota 57501

Jack Merwin, Secretary
Department of Game, Fish & Parks
Anderson Building
Pierre, South Dakota 57501

James Van Loan, Director
Office of Energy Policy
Foss Building
Pierre, South Dakota 57501

B5/01

SOUTH Dakota Department of
Environmental Protection
Pierre, South Dakota 57501
Phone (605) 224-3351

May 10, 1978

Col. Forrest T. Gay, III
District Engineer
U.S. Army Corp of Engineers
St. Paul District
Room 1222
P.O. and Custom House
180 East Kellogg Blvd.
St. Paul, Minnesota 55101

Dear Col. Gay:

On May 3, 1978, the Natural Resources Sub-cabinet designated Mr. Albert Griffiths as the contact person in the Executive Branch of South Dakota State Government for the Upper Minnesota River Sub-Basin Implementation Study under P.L. 87-639. All communications from the Executive Branch of State Government regarding this study will be channeled through Mr. Griffiths, and we respectfully request that all communications from Federal, State and local agencies in Minnesota to South Dakota State Government be channeled through him. Mr. Griffiths' title and address is Director, Conservation Division, South Dakota Department of Agriculture, Anderson Building, Pierre, South Dakota. His telephone is (605) 773-3258. Thank you.

Sincerely,

Allyn O. Loekken, Secretary
Department of Environmental Protection

cc: Richard F. Kneip, Governor
State of South Dakota
Mr. Albert Griffiths, Director, Division of Conservation
S.D. Dept. of Agriculture
Ben Orsbon, Executive Policy Aide
Bureau of Planning
Natural Resources Sub-cabinet

B5/07

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DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

DEPARTMENT OF AGRICULTURE
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

15 May 1978

Mr. George Alexander, Jr.
Regional Administrator, Region V
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

ATTN: Mr. Ronald Mustard

Dear Mr. Alexander:

Our letter of 13 April 1978 advised you of the current Minnesota River subbasin implementation study being conducted jointly by the Soil Conservation Service and the Corps of Engineers under authorization of Public Law 87-639. We understand that the lead time was too short for you to respond to our invitation to attend a meeting to discuss specific water quality issues. The South Dakota Department of Environmental Protection also was not able to send a representative to the meeting.

This confirms our recent contact with Mr. William Frans of your office to set up another meeting with the same parties on 21 June 1978 at 9 a.m. in room 1220 of the Corps of Engineers office. We have also confirmed the meeting date with Mr. Lanny Reissig, Minnesota Pollution Control Agency, and Mr. Albert Griffiths, Division of Conservation, South Dakota.

Specific issues and questions we would like to address at the meeting are listed on inclosure 1. In April we met with representatives of the Minnesota Pollution Control Agency to discuss these points. Inclosure 2 states the Corps of Engineers-Soil Conservation Service position on the issues. For your convenience we are furnishing an additional copy of the draft plan of study which provides an overview of the investigation.

Mr. William Geise, Environmental Protection Agency, Region VIII, has advised us that studies of the entire upper Minnesota River basin including the Yellow Bank River in South Dakota, usually under the jurisdiction of Region VIII, should be coordinated with your office.

We trust that participation of your water quality experts will resolve issues early in the study and help to assure formulation of acceptable flood damage reduction plans for management of the water and related resources in the basin.

Sincerely,

HARRY M. MAJOR
State Conservationist
Soil Conservation Service

FORREST T. GAY, III
Colonel, Corps of Engineers
District Engineer

3 Incl
As stated

UPPER MINNESOTA RIVER SUBBASIN IMPLEMENTATION STUDY
Public Law 87-639

WATER QUALITY ISSUES

a. Existing water quality standards for the subbasin tributaries. Do the tributaries now meet these standards? What water quality standards will the State establish for the reservoir and the stream reaches downstream of a dam? If water quality standards are not currently met for the basin tributaries, do you expect full compliance with standards after reservoir development?

b. Do you have any specific concerns regarding the impacts of potential channel modifications on the assimilative capacity of streams? What parameters are of concern? Is any sampling, monitoring, or modeling needed to determine the water quality impacts of potential channel modifications? If needed, what specific studies do you require and what level of detail is acceptable to your agency?

c. What do the State agencies view as beneficial uses of the basin tributaries? Is reservoir development compatible with these beneficial uses? Is stream channelization development compatible with these beneficial uses? Is the elimination of cross-subbasin flow compatible with these beneficial uses? Are high- and low-flow diversion channel developments compatible with these beneficial uses? If any of these types of development result in violation of existing water quality standards of the tributaries, under what circumstances and conditions would the Environmental Protection Agency accept the State agency's:

(1) Variances in the water quality standards for parameters within a specific use classification?

(2) Changes in the use classification for a segment of the stream?

(3) Changes in the use classification for the entire stream?

d. Would dry dam flood control reservoir type impoundments with short-term detention times be considered to impose any significant downstream water quality problems? What minimum detention time would be considered sufficient to potentially impact on downstream water quality?

e. Would anticipated eutrophication of a reservoir development result in unequivocal opposition of the Environmental Protection Agency to that project?

f. Under what conditions, if any, would beneficial impacts of flood control, water quality, recreation, and fish and wildlife be sufficient to alter opposition of the Environmental Protection Agency and State agencies to the potential developments not fully complying with their water quality standards?

g. Would current state-of-the- art methods of mitigation or elimination of potential water problems downstream of a reservoir such as a multilevel outlet structure, aeration of the reservoir to prevent thermal stratification, or any other methods and coordination of the reservoir operation plan be acceptable?

h. The water quality monitoring program including the required parameters and frequency and duration of data collection. What physical, chemical, and biological parameters are used to determine whether a reservoir, channel modification, or diversion is acceptable and meets the beneficial uses of a river?

i. A discussion of any predictive models that should be included in the water quality studies to evaluate the parameters.

j. Specific items that should be included in the water quality report. What constitutes an adequate report and documentation?

k. At what phases of project planning should (1) preliminary water quality evaluation be made and reported based on available data and (2) detailed water quality data collection and analysis be conducted and reflected in the planning process and environmental impact statement?

l. Any other related matters as deemed appropriate.

WORK SHEET
Specific Issues and Questions

a.

(1) Existing water quality: General classification 2C, 3B basin-wide except for some segments in the Redwood Basin classified as trout streams. Those not named are 2B.

(2) Do tributaries meet standards? Major problems in Lac qui Parle and Yellow Medicine basins are violations of coliform and turbidity standards and elevated levels of nitrates and TSS. Nonpoint sources are significant and water quality standards cannot be expected to be maintained until nonpoint sources are controlled.

Monitored reaches of the Cottonwood are characterized by high levels of fecal coliform, turbidity, nutrients, and particulate matter. While noncompliant point sources contribute, the major source of pollution is probably nonpoint in the Cottonwood basin. Water quality of the Redwood is good. No data available for the Yellow Bank.

(3) Water quality standards to be established: One of the points to establish is whether these intermittent streams are to be classified as Effluent Limited Segments or Water Quality Segments. Nonpoint sources of pollution are expected to be reduced because of the proposed SCS land treatment program.

(4) Full compliance with standards after reservoir development: Group discussion.

b.

(1) Impact of potential channel modifications on assimilative capacity: None of these intermittent streams have any assimilative capacity for a continuous loading.

(2) Parameters of concern: Change in water temperature is thought to be the major parameter. We have done some modeling of temperature differences in regard to other channel modification projects.

(3) Sampling, monitoring, modeling: We propose no sampling or monitoring for channel modifications. Could do some temperature modeling.

(4) Specific studies and level of detail: Group discussion.

Incl 2

WORK SHEET - Specific Issues and Questions

c.

(1) Beneficial uses and variance in water quality standards and use classifications: In general, we anticipate that reservoirs would improve water quality by trapping of sediments and reducing downstream channel scour. Also, slower release rates would raise base flow conditions in some instances.

d.

(1) Would dry dams cause any significant downstream water quality problems: We do not anticipate any problems. Information from University of Minnesota (Shapiro) is that detention times of less than 10 days would have no effect on water quality.

e.

(1) Eutrophication: All of the reservoirs are expected to be eutrophic because of nature of soils, land use, and nutrient rich low base flow levels.

f.

(1) Position of EPA and State agencies if potential developments do not fully comply with water quality standards: No comment.

g.

(1) Current state-of-the-art methods for mitigating downstream water quality problems: The various methods such as aeration or multilevel outlet structures appear to be generally beneficial, and all have been used.

h.

(1) Water quality monitoring program: We propose to sample existing impoundments thought to be similar and representative to the proposed reservoirs. Samples would be taken during spring, summer, and fall at various depths in each pool. Standard parameters would be taken.

i.

(1) Predictive models: For dry dams or extremely shallow impoundments, we know of no predictive models. For the deeper (30 feet or more) dams the Corps has a predictive model. We do not propose to use any predictive models for this study.

WORK SHEET - Specific Issues and Questions

j.

(1) Adequate report and documentation: The report will document all water quality sampling data and land uses upstream of each reservoir. This will also include all data on existing reservoirs which will be used to predict water quality in the proposed impoundments. The report will show all rationale used in predicting water quality conditions. We do not plan to investigate water quality conditions downstream to the Minnesota River.

| RIVER BASIN | DRAINAGE AREA | FLOW CFS | | | RUNOFF | FLOW DURATION | | LOW FLOW CFS | | USGS WATER QUALITY DATA |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sq. Mi. | Max. | Min. | Avg. | In./Yr. | Discharge cfs | Percent of Time Discharge Equal to or Greater | 7-Day | 10-Year | |
| YELLOW BANK RIVER near Odessa, MN | 398 | 6,970 | 0 | 56.9 | 1.94 | 1.0<br>9.6 | 91.3<br>48.2 | .1 | | USGS currently taking specific conductance, temperature & sediment. |
| LAK QUI PARLE RIVER near Lac Qui Parle, MN | 983 | 29,400 | 0 | 119 | 1.64 | .20<br>13.0 | 86.6<br>52.3 | | .1 | |
| SOUTH BRANCH YELLOW MEDICINE at Minneota, MN | 111 | 4,430 | 0 | 20.3 | 2.48 | .10<br>1.70 | 81.3<br>53.2 | | | |
| YELLOW MEDICINE RIVER near Granite Falls, MN | 653 | 17,200 | 0 | 102 | 2.12 | 2.20<br>12.0 | 91.0<br>52.9 | | .4 | |
| REDWOOD RIVER at Marshall, MN | 307 | 5,590 | 0 | 45.1 | 1.99 | 1.30<br>6.10 | 91.9<br>55.8 | | .1 | |
| REDWOOD RIVER near Redwood Falls, MN | 697 | 19,700 | 0 | 98.8 | 1.92 | 1.50<br>17.0 | 92.3<br>51.0 | | .3 | |
| COTTONWOOD RIVER near New Ulm, MN | 1,280 | 28,700 | .5 | 267 | 2.83 | 10.0<br>51.0 | 90.5<br>51.6 | | 2.5 | USGS Water Quality discontinued 1976 |

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

DEPARTMENT OF AGRICULTURE
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

15 May 1978

Ms. Sandra Gardebring
Executive Director
Minnesota Pollution Control Agency
1935 West County Road B-2
Roseville, Minnesota 55113

Dear Ms. Gardebring:

Our letter of 13 April 1978 advised you of the current Minnesota River subbasin implementation study being conducted jointly by the Soil Conservation Service and the Corps of Engineers under authorization of Public Law 87-639.

In April we met with representatives of your office to discuss water quality issues associated with the study. The South Dakota Department of Environmental Protection and the U.S. Environmental Protection Agency were unable to send representatives to the meeting. Thus, we have set up another meeting with the same parties on 21 June 1978 at 9 a.m. in room 1220 of the Corps of Engineers office. We confirmed the meeting date with Mr. Lanny Paissig of your office, Mr. William Franz of the U.S. Environmental Protection Agency, and Mr. Albert Griffiths, Division of Conservation, South Dakota.

Specific issues and questions we would like to address at the meeting are listed on inclosure 1. Inclosure 2 states the Corps of Engineers-Soil Conservation Service position on the issues. For your convenience we are furnishing an additional copy of the draft plan of study which provides an overview of the investigation.

We trust that participation of your water quality experts will resolve issues early in the study and help to assure formulation of acceptable flood damage reduction plans for management of the water and related resources in the basin.

Sincerely,

HARRY M. MAJOR
State Conservationist
Soil Conservation Service

FORREST T. GAY, III
Colonel, Corps of Engineers
District Engineer

3 Incl
As stated

Copy furnished:
Mr. Lanny Paissig
Water Quality Division
Minnesota Pollution Control Agency
Roseville, Minn. 55113

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

DEPARTMENT OF AGRICULTURE
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

15 May 1978

Mr. Albert Griffiths
Director
Division of Conservation
Anderson Building
Pierre, South Dakota 57501

Dear Mr. Griffiths:

We are writing in regard to the current Minnesota River subbasin implementation study being conducted jointly by the Soil Conservation Service and the Corps of Engineers under authorization of Public Law 87-639. We scheduled a meeting in April to discuss water quality issues, but the South Dakota Department of Environmental Protection and the U.S. Environmental Protection Agency were unable to send representatives to the meeting.

This confirms our recent contact with you to set up another meeting with the same parties on 21 June 1978 at 9 a.m. in room 1220 of the Corps of Engineers office. We have also confirmed the meeting date with Mr. William Franz, U.S. Environmental Protection Agency, and Mr. Lanny Peissig, Minnesota Pollution Control Agency.

Specific issues and questions we would like to address at the meeting are listed on inclosure 1. In April we met with representatives of the Minnesota Pollution Control Agency to discuss these points. Inclosure 2 states the Corps of Engineers-Soil Conservation Service position on the issues. For your convenience we are furnishing an additional copy of the draft plan of study which provides an overview of the investigation.

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Sincerely,

HARRY M. MAJOR
State Conservationist
Soil Conservation Service

FORREST T. GAY, III
Colonel, Corps of Engineers
District Engineer

3 Incl
As stated

Copy furnished:
Dr. Allyn Lenkmar, Secretary, South Dakota Dept of Environmental Protection
Pierre, South Dakota

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

JUN 20 1978

Colonel Forrest T. Gay, III
District Engineer
U.S. Army Engineer District, St. Paul
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Gay:

I appreciate the letters of April 13, 1978 and May 15, 1978, signed by you and Mr. Harry M. Major of the Soil Conservation Service, in regard to the proposed flood control program for the Minnesota River Basin, which is being coordinated with the Soil Conservation Service. The two letters requested certain information and our views on some aspects of the project.

We have addressed these questions in our correspondence regarding the proposed Twin Valley Reservoir project. I see no need at this time to reiterate the position of this Agency in regard to water quality. The water quality studies should ultimately determine how the project will affect water quality standards and whether or not the predicted water quality problems can be resolved.

To facilitate a discussion and begin the studies for this project, a meeting has been arranged in your offices on June 21, 1978, at 9:00 A.M. Members of my staff will be in attendance and will assist you in formulating the water quality studies.

I appreciate your requesting our input at this early date. If I can be of any further assistance, please contact me again.

Sincerely yours,

for Thomas E. Jorling

Valdas V. Adamkus
Acting Regional Administrator

National Wildlife Federation

1412 16TH ST., N.W., WASHINGTON, D.C. 20036 Phone: 202-483-1550

1825 Nevada Ave. S.
Minneapolis - 55426
June 22, 1978

Mr. L.K. Lappegaard
Soil Conservation Service
316 N. Robert Street
St. Paul, Minn. 55101

Dear Mr. Lappegaard:

I would appreciate receiving all pertinent information, including the draft project report, on the Upper Minnesota River Subbasin Implementation Project.

Please send this information to the Minneapolis address in the upper right hand part of this page.

I would also appreciate it if you'd send duplicate copies of the same information to the following:

Roger Pries, President
S.D. Wildlife Federation
812 N. Monroe
Pierre, S.D. 57501

Gordon Meyer, President, MCF
735 E. Crystal Lake Road
Burnsville, Minn. 55337

Dr. Keith Harmon, Field Repr.
Wildlife Management Institute
Rt. 1, Box 122
Firth, Neb. 68358

If the draft report is a draft environmental impact statement on this project, please inform us of the review and comment deadlines and such relevant information. Thank you.

Sincerely,

Charles J. Griffith

Charles J. Griffith
Regional Executive

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

DEPARTMENT OF AGRICULTURE
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

7 July 1978

Mr. Valdas V. Adamkus
Acting Regional Administrator, Region V
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

ATTN: Mr. Ronald Mustard

Dear Mr. Adamkus:

We appreciate the U.S. Environmental Protection Agency's participation in the 21 June 1978 interagency meeting held at our office. The meeting concerned specific water quality issues associated with a water and related land resource study of the upper Minnesota River subbasins conducted jointly by the Soil Conservation Service and the Corps of Engineers under authorization of Public Law 87-639. A roster of participants and an agenda for the meeting are inclosed.

As a follow-up to discussions at the meeting, we would like the Environmental Protection Agency to furnish a letter stating its acceptance of the following:

a. The Environmental Protection Agency has approved the State water quality standards and classification of streams in the study area by Minnesota and South Dakota. South Dakota has minimal water quality data on its streams and cannot judge which ones currently meet the classified standards. Minnesota has water quality data on the major streams but information is incomplete for the headwaters. The Environmental Protection Agency and the two States agree that water quality with reservoir project development should equal or exceed the natural condition prior to construction.

b. The Environmental Protection Agency and the States consider channelization as a last alternative measure of streamflow control. The National Environmental Policy Act and U.S. Department of Agriculture-U.S. Fish and Wildlife Service Channel Guidelines are referenced guidelines. The Environmental Protection Agency and the States list temperature as a primary water quality parameter. Trout streams are of prime concern and South Dakota transmitted a listing of State trout streams of which six are in the study area headwaters. Minnesota lists two trout streams in the study area. South Dakota will provide its water plan for study use.

c. Generally, uses of streams are set by regulation and are not allowed to be changed by project development.

d. Wet dams with sediment or conservation pools are desirable to the State. The agencies do not anticipate water quality problems with dry dams. However, with both wet and dry dams, impacts will be judged by downstream effects.

e. The Environmental Protection Agency and the States agree that some wet dams will be eutrophic. This is a concern if reservoirs are in an accelerated rate of eutrophication. The Environmental Protection Agency recommends the use of retention - loading curves during design. All of the agencies agree that adverse downstream impacts caused by reservoir discharges would be a violation of water quality standards.

f. Any developmental beneficial impacts will not be accepted as trade-offs for adverse water quality impacts. Full compliance with the water quality standards is the objective. The agencies would respond specifically to actual project plans. They accept mitigation for nonpredictive adverse impacts.

g. A suggested water quality monitoring program agreed to by the three agencies is as follows:

(1) Four existing reservoirs, representative of the major land resource areas of the study area, will be monitored as also representative of those prospective sites with 50- to 100-square-mile drainage areas on nearby streams.

(2) Measurements of the stream inflow, the impoundment, and outflow in the spring will be taken. Monitoring will occur three times in the summer and once during the winter.

(3) Parameters to be monitored will be agreed upon by the study work group and State agencies. Minnesota desires that sampling for pesticides and herbicides be done at least once a year in all major reservoirs.

(4) All trout streams will be included in the stream monitoring program.

h. Predictive modeling is not applicable to the potential reservoir impoundments in the study area.

i. There are a few situations of possible municipal effluent discharge into potential reservoir impoundments which should be coordinated with local interests for possible improved treatment to remove contaminants.

Mr. Valdas V. Adamkus 7 July 1978

For us to proceed with the water quality study in a timely manner and to advise congressional and local interests of agreements made between the U.S. Environmental Protection Agency, Minnesota Pollution Control Agency, South Dakota Department of Environmental Protection, and Corps of Engineers on the water quality issues, we would appreciate your direct response to this letter by 4 August 1978. Should you have any questions, please contact us. Mr. Peter Fischer, Chief, Hydraulic Engineering and Foundation Materials Branch (612-725-7567), or Mr. Robert Northrup, Chief, General Investigations Section (612-725-7559), can provide additional information.

Sincerely,

2 Incl
As stated

HARRY M. MAJOR
State Conservationist
Soil Conservation Service

WALTER L. HEMM
Lieutenant Colonel, CE
Acting District Engineer

CF:
Mr. Keith L. Beseke
Western District Office
U.S. Environmental Protection Agency
7401 Lyndale Avenue South
Minneapolis, Minnesota 55423

UPPER MINNESOTA RIVER SUBBASINS STUDY - WATER QUALITY
MEETING WITH SCS, COFE, EPA, MPCA, SOUTH DAKOTA
21 JUNE 1978

| NAME | AGENCY | POSITION OR TITLE |
|---|---|---|
| Stan Kummer | Corps of Engineers | Study Cochairman |
| Dan Hartmann | Corps of Engineers | Water Quality Unit |
| Lanny Peissig | Minnesota Pollution Control Agency | Section of Surface & Groundwater |
| Laurel Lappegaard | Soil Conservation Service | Study Cochairman |
| Dan Reinartz | Corps of Engineers | Water Quality Unit |
| Ordean Finkelson | Soil Conservation Service | Water Quality Unit |
| Ray Cope | Soil Conservation Service | W.Q. Spec., MTSC, Lincoln, NE. |
| Bill Franz | Environmental Protection Agency | Environmental Protection Specialist |
| Lee Baron | South Dakota Department of Environmental Protection | Water Quality Program |
| Duane Murphey | South Dakota Department of Environmental Protection | Water Quality Section Chief |
| Ken Krug | Soil Conservation Service | River Basin-Watersheds-St. Paul |
| Albert Griffiths | South Dakota Department of Agriculture | State Liaison |
| Gary G. Rott | Minnesota Pollution Control Agency | Surface and Groundwaters Section |
| Robert Northrup | Corps of Engineers | Chief, General Investigations Section |

AGENDA

UPPER MINNESOTA RIVER SUBBASIN STUDY
CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE
WATER QUALITY ISSUES

21 JUN 1978

| | | |
|---|---|---|
| 9:30 A.M. | Introductory Remarks | Stan Kummer |
| | Study Background | Laurel Lappegard |
| | Slide Presentation | Stan Kummer |
| 11:00 A.M. | Specific Issues and Questions | Group Discussion |
| 12:00 Noon | Lunch | |
| 1:00 P.M. | Corps of Engineer Reservoirs | Dan Hartmann |
| | Soil Conservation Service Reservoirs | Ordean Finkleson |
| 1:45 P.M. | Water Quality Sampling Program | Group Discussion |
| 4:00 P.M. | Summary | Stan Kummer |

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

7 July 1978

Ms. Sandra Gardebring
Executive Director
Minnesota Pollution Control Agency
1935 West County Road B-2
Roseville, Minnesota 55113

Dear Ms. Gardebring:

We appreciate the participation of the Minnesota Pollution Control Agency in the 21 June 1978 interagency meeting held at our office. The meeting concerned specific water quality issues associated with a water and related land resources study of the upper Minnesota River subbasins conducted jointly by the Soil Conservation Service and the Corps of Engineers under authorization of Public Law 87-639. A roster of participants and an agenda for the meeting are inclosed.

As a follow-up to discussions at the meeting, we would appreciate a letter stating the Minnesota Pollution Control Agency's acceptance of the following:

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c. Generally, uses of streams are set by regulation and are not allowed to be changed by project development.

d. Wet dams with sediment or conservation pools are desirable to the State. The agencies do not anticipate water quality problems with dry dams. However, with both wet and dry dams, impacts will be judged by downstream effects.

e. The Environmental Protection Agency and the States agree that some wet dams will be eutrophic. This is a concern if reservoirs are in an accelerated rate of eutrophication. The Environmental Protection Agency recommends the use of retention - loading curves during design. All of the agencies agree that adverse downstream impacts caused by reservoir discharges would be a violation of water quality standards.

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Ms. Sandra Gardebring 7 July 1978

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Sincerely,

2 Incl
As stated

HARRY M. MAJOR
State Conservationist
Soil Conservation Service

WALTER L. HEINE
Lieutenant Colonel, CE
Acting District Engineer

CF:
Mr. Lanny Peissig
Water Quality Division
Minnesota Pollution Control Agency
1935 West County Road B-2
Roseville, Minnesota 55113

Mr. Gary G. Rott
Water Quality Division
Minnesota Pollution Control Agency
1935 West County Road B-2
Roseville, Minnesota 55113

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

DEPARTMENT OF AGRICULTURE
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

7 July 1978

Mr. Albert Griffiths
Director
Division of Conservation
South Dakota Department of Agriculture
Anderson Building
Pierre, South Dakota 57501

Dear Mr. Griffiths:

We appreciate the participation of the South Dakota Department of Environmental Protection in the 21 June 1978 interagency meeting held at our office. The meeting concerned specific water quality issues associated with a water and related land resources study of the upper Minnesota River subbasins conducted jointly by the Soil Conservation Service and the Corps of Engineers under authorization of Public Law 87-639. A roster of participants and an agenda for the meeting are inclosed.

As a follow-up to discussions at the meeting, we would appreciate a letter stating the South Dakota Department of Environmental Protection's acceptance of the following:

a. The Environmental Protection Agency has approved the State water quality standards and classification of streams in the study area by Minnesota and South Dakota. South Dakota has minimal water quality data on its streams and cannot judge which ones currently meet the classified standards. Minnesota has water quality data on the major streams but information is incomplete for the headwaters. The Environmental Protection Agency and the two States agree that water quality with reservoir project development should equal or exceed the natural condition prior to construction.

b. The Environmental Protection Agency and the States consider channelization as a last alternative measure of streamflow control. The National Environmental Policy Act and U.S. Department of Agriculture-U.S. Fish and Wildlife Service Channel Guidelines are referenced guidelines. The Environmental Protection Agency and the States list temperature as a primary water quality parameter. Trout streams are of prime concern and South Dakota transmitted a listing of State trout streams of which six are in the study area headwaters. Minnesota lists two trout streams in the study area. South Dakota will provide its water plan for study use.

c. Generally, uses of streams are set by regulation and are not allowed to be changed by project development.

d. Wet dams with sediment or conservation pools are desirable to the State. The agencies do not anticipate water quality problems with dry dams. However, with both wet and dry dams, impacts will be judged by downstream effects.

e. The Environmental Protection Agency and the States agree that some wet dams will be eutrophic. This is a concern if reservoirs are in an accelerated rate of eutrophication. The Environmental Protection Agency recommends the use of retention - loading curves during design. All of the agencies agree that adverse downstream impacts caused by reservoir discharges would be a violation of water quality standards.

f. Any developmental beneficial impacts will not be accepted as trade-offs for adverse water quality impacts. Full compliance with the water quality standards is the objective. The agencies would respond specifically to actual project plans. They accept mitigation for nonpredictive adverse impacts.

g. A suggested water quality monitoring program agreed to by the three agencies is as follows:

(1) Four existing reservoirs, representative of the major land resource areas of the study area, will be monitored as also representative of those prospective sites with 50- to 100-square-mile drainage areas on nearby streams.

(2) Measurements of the stream inflow, the impoundment, and outflow in the spring will be taken. Monitoring will occur three times in the summer and once during the winter.

(3) Parameters to be monitored will be agreed upon by the study work group and State agencies. Minnesota desires that sampling for pesticides and herbicides be done at least once a year in all major reservoirs.

(4) All trout streams will be included in the stream monitoring program.

h. Predictive modeling is not applicable to the potential reservoir impoundments in the study area.

i. There are a few situations of possible municipal effluent discharge into potential reservoir impoundments which should be coordinated with local interests for possible improved treatment to remove contaminants.

Mr. Albert Griffiths 7 July 1978

For us to proceed with the water quality study in a timely manner and to advise congressional and local interests of agreements made between the U.S. Environmental Protection Agency, Minnesota Pollution Control Agency, South Dakota Department of Environmental Protection, and Corps of Engineers on the water quality issues, we would appreciate your direct response to this letter by 4 August 1978. Should you have any questions, please contact us. Mr. Peter Fischer, Chief, Hydraulic Engineering and Foundation Materials Branch (612-725-7367), or Mr. Robert Northrup, Chief, General Investigations Section (612-725-7359), can provide additional information.

Sincerely,

2 Incl
As stated

HARRY M. MAJOR
State Conservationist
Soil Conservation Service

WALTER L. HEME
Lieutenant Colonel, CE
Acting District Engineer

CF:
Dr. Aliya Lochner
Secretary
South Dakota Department of Environmental Protection
Pierre, South Dakota 57501

**Attendance List**

**Advisory Committee Tour**

UMRS (639 Study) July 27, 1978

| Name | Organization | Location |
|---|---|---|
| **Federal Agencies** | | |
| Laurel Lappegaard | SCS - USDA | St. Paul, MN |
| Stan Kummer | Corps of Engineeers | St. Paul, MN |
| Jim Ruone | UMRBC | Minneapolis, MN |
| Mel Niehaus | SCS - USDA | Ivanhoe, MN |
| Dave Browning | SCS - USDA | Ivanhoe, MN |
| Larry Schmidt | SCS - USDA | Marshall, MN |
| Keith Roble | SCS - USDA | Marshall, MN |
| Dennis Holme | Corps of Engineers | St. Paul, MN |
| Tom Fischer | SCS - USDA | Marshall, MN |
| Ivan Wilkinson | SCS - USDA | St. Paul, MN |
| Paul Nielsen | SCS - USDA | Lincoln, NE |
| Nancy B. Walters | U.S. Fish & Wildlife Service | St. Paul, MN |
| Jon DeGroot | SCS - USDA | St. Paul, MN |
| William Stokes | SCS - USDA | St. Paul, MN |
| Harry Major | SCS - USDA | St. Paul, MN |
| Dan Peinartz | Corps of Engineers | St. Paul, MN |
| **State Agencies (MN) & other Gov't. Units** | | |
| Arnold Onstad | SMRBB | Spring Grove, MN |
| Tom Kalitowski | MN Water Planning Board | St. Paul, MN |
| Jack Ditmore | MN Water Planning Board | St. Paul, MN |
| Michael Sobota | Southwest RDC | Slayton, MN |
| Carl M. Johnson | SMRBB | St. Peter, MN |
| Elvin Tews | MDNR | Spicer, MN |
| Bob Overley | Upper MN Valley RDC | Appleton, MN |
| Thomas Kucera | DNR - Fish & Wildlife | St. Paul, MN |
| Robert Kirsch | MN DNR - Eclogical Serv. Sec. | St. Paul, MN |
| Marylyn Deneen | Soil & Water Conv. Board | St. Paul, MN |
| Earl Huber | MDNR (Ecological Services) | St. Paul, MN |
| Hedia Rieke | MDNR | St. Paul, MN |
| Marilyn Lundberg | SMRBB | St. Paul, MN |
| Leonard Pikal | Soil & Water Conv. Board | Brownton, MN |
| **Minnesota Legislature** | | |
| Jim Nichols | MN Senate | Lake Benton, MN |
| Jerome O. Gunderson | MN State Senator | Mabel, MN |
| **Local Officials** | | |
| Milo C. Hanson | Area V Director | Dawson, MN |
| Linda Lensing | Lac qui Parle Yellow Bk. WS Dist. | Canby, MN |
| Gloria Pearson | Area II Secretary | Dawson, MN |
| Willie Beecher | Lac qui Parle Yellow Bk. WS Dist. | Canby, MN |
| John Boulton | Area II Treas. | Taunton, MN |

State Agencies - South Dakota)

| | | |
|---|---|---|
| Lee Baron | So. Dak. Dept. Environ. Prot. | Pierre, So. Dak. |
| Leo Ritter | So. Dak. Nat. Res. Dev. | Pierre, So. Dak. |
| Ray Christensen | So. Dak. Dept. of Agriculture | Pierre, So. Dak. |
| John Kirk | So. Dak. WPF | Pierre, So. Dak. |

Environmental Organizations

| | | |
|---|---|---|
| Alan Wentz | Representing National Audabon Society | Brockings, So. Dak. |
| John Gallagher | National Audubon Society | Jamestown, No. Dak. |

Other

| | |
|---|---|
| Maxine Gunderson | Mabel, MN |

UPPER MINNESOTA RIVER SUBBASINS IMPLEMENTATION STUDY (PUBLIC LAW 87-639)
CORPS OF ENGINEERS AND SOIL CONSERVATION SERVICE

PERSONNEL INVOLVED

| | Telephone Number |
|---|---|
| **STUDY ADVISORY COMMITTEE** | |
| Chairperson Arnold Onstad, Chairperson Southern Minnesota River Basin Board | (507) 498-5323 |
| George Bekeris, Area Manager, U.S. Fish & Wildlife Service | (612) 725-7131 |
| Colonel Forrest T. Gay, III, District Engineer St. Paul District, Corps of Engineers | (612) 725-7501 |
| Tom Kalitowski, Minnesota Water Planning Board | (612) 296-1424 |
| Harry Major, Minnesota State Conservationist, Soil Conservation Service | (612) 725-7675 |
| Willard Pearson, Chairperson - Area II Action Committee | (612) 769-4515 |
| **SOIL CONSERVATION SERVICE** | |
| Jon DeGroot, Assistant State Conservationist | (612) 725-7684 |
| Ivan Wilkinson, River Basin Watershed Planning Staff Leader | (612) 725-7682 |
| Laurel K. Lappegaard, Study Cochairman | (612) 725-7158 |
| Tom Fischer, Area Conservationist, Marshall, Minnesota | (507) 532-2240 |
| **CORPS OF ENGINEERS** | |
| Robert Northrup, Chief, General Investigations Section, Planning Branch | (612) 725-7559 |
| Stan Kummer, Study Cochairman | (612) 725-7601 |
| **U.S. FISH AND WILDLIFE SERVICE** | |
| Nancy Bannister, Study Group Representative | (612) 725-7131 |
| **MINNESOTA WATER PLANNING BOARD** | |
| Jack Ditmore, Administrative Asistant | (612)296-1424 |
| **MINNESOTA DEPARTMENT OF NATURAL RESOURCES** | |
| Hedia Rieke, Study Group Representative | (612) 296-4800 |
| **AREA II ACTION COMMITTEE** | |
| Chairperson Willard Pearson, President, Lac qui Parle Watershed District | (612) 769-4515 |
| John Boulton, President, Yellow Medicine River Watershed District | (507) 296-4668 |
| Torgny Anderson, Retired Chairperson, Lyon County Board | |
| Jerry Siegel, Manager, East Dakota Conservancy District | |
| Roy Syverson, Chairperson, Redwood County Board | |
| **SOUTHERN MINNESOTA RIVERS BASIN BOARD** | |
| Marilyn Lundberg, Administrative Assistant | (612) 296-0676 |
| **SOIL AND WATER CONSERVATION BOARD** | |
| Vern Reinert, Executive Director | (612) 296-3767 |
| _____, Engineer | |
| **SOUTH DAKOTA - NATURAL RESOURCES** | |
| Albert Griffiths (Contact Person) | (605) 773-3258 |
| **MINNESOTA POLLUTION CONTROL AGENCY - DIVISION OF WATER QUALITY** | |
| Lanny R. Peissig, Division Head - Gary Rott | (612) 296-7242 |
| **ENVIRONMENTAL PROTECTION AGENCY (EPA)** | |
| William Franz, EPA, Chicago, Illinois | (312) 353-2207 |
| Keith Beseke, EPA, Minneapolis Office | (612) 725-3272 |

SOUTH DAKOTA
Department of Agriculture
DIVISION OF CONSERVATION
Anderson Building, Room 322 • Pierre, South Dakota 57501
Phone 605/224-3258
Phone 605/773-3258

July 19, 1978

Mr. Stan Kummer, Study Coordinator
Department of the Army
St. Paul District, Corp of Engineers
St. Paul, Minnesota 55101

Dear Stan,

This is the only response obtained to date concerning July 7, 1978 correspondence.

We hope that this communication helps to clarify various positions of South Dakota relating to the Upper River Sub-Basin Study.

Sincerely,

Albert L. Griffiths, Director
Division of Conservation

South Dakota Department of
Environmental Protection
Pierre, South Dakota 57501
Phone (605) 224-3351



July 14, 1978

Al Griffiths, Director
Division of Conservation
South Dakota Department of Agriculture
Anderson Building
Pierre, South Dakota 57501

Dear Al:

We have reviewed the copy of the letter dated July 7, 1978, from the Soil Conservation Service and Corps of Engineers to you concerning the meeting held June 21, 1978, to discuss the Minnesota River Sub-Basin implementation study. We agree with their comments A through H with the following comments and exceptions:

Item C should be modified to read "gen ly uses of the stream are set by regulation and are not allowed to be do..graded by project development. In those cases where a project development would allow higher beneficial uses, those uses would be considered for adoption by the Board of Environmental Protection.

Item D. Statements about wet and dry dams are generalizations. There may be specific situations where certain dams may be undesirable. That will be determined on a case-by-case basis at a later date by reviewing proposed sites and designs.

Item G(1). Four reservoirs are the suggested number to be representative of prospective sites. It should not be considered a firm number. We believe that anywhere from three to six could be considered adequate.

Item G(2). As we discussed at the meeting, monitoring four times a year at these sites may be adequate to represent the conditions in the impoundment and the outflow. A reservoirs inflow may be highly variable. It will probably be necessary for a more frequent sampling analysis on these tributary inflows. In those cases where the inflow occurs only after spring melt or rainfall events, it may be necessary to have someone either on-site or very near to sample during or shortly after those events.

To date we have been pleased with the actions taken by the Corps of Engineers and Soil Conservation Service regarding this study.

Should you or they have any further questions regarding the understanding of our policies or design and implementation of the monitoring, please contact us as soon as possible.

Sincerely,

Allyn O. Lockner, Secretary
Department of Environmental Protection

C4/13

Minnesota Pollution Control Agency

August 8, 1978

Mr. Harry M. Major
State Conservationist
Soil Conservation Service
316 North Robert Street
St. Paul, Minnesota 55101

Lieutenant Colonel Walter Heme
Acting District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Mr. Major and Lieutenant Colonel Heme:

Reference is made to your July 7, 1978 letter concerning specific water quality issues associated with a water and related land resources study of the Upper Minnesota River.

Our Agency is basically in agreement with the material provided in that letter except for item (h). It is felt that predictive modeling is an applicable and useful tool which can be used to predict environmental impacts if other forms of analysis such as retention - loading curves, as identified in your letter, are found to be inadequate. The methods of assessment selected need to adequately identify potential water quality problems so that these problems can be evaluated and minimized. Therefore, as the assessment procedure progresses, it may become evident that more intense work will be needed in selected areas.

The following additional information is also provided. Dams should be adequately designed so that they do not reduce the water quality or low flow in the waterway. Minnesota has two trout streams affected by the proposed dams. They are Canby Creek and the Redwood River between Russel and Lynd in Lyon County. There are four other trout streams in the study area; Ten Mile Creek in Lac Qui Parle County, Ramsey Creek in Redwood County, Hindeman Creek in Brown County, and John's Creek in Brown County. Our Agency also has some concern with the impacts of dry dams on water quality.

Phone 612/296-7301
1935 West County Road B2, Roseville, Minnesota 55113
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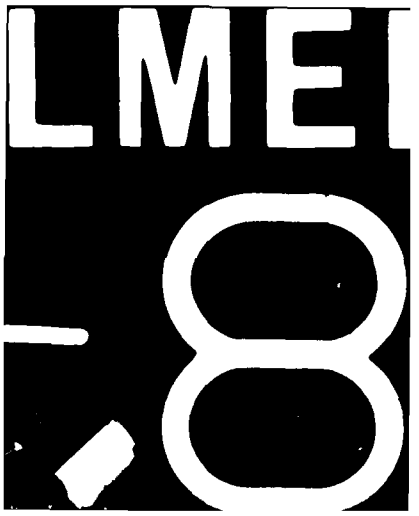
It is felt that it would be beneficial to do an evaluation of an existing dry dam to determine environmental impacts. When studies of existing impoundments are conducted, flow and water quality should be measured at the same time so that loadings can be calculated. It is also recommended that pesticide and herbicide monitoring be conducted when these chemicals are being applied to the farmland.

If you have any questions, please feel free to contact me.

Yours truly,

Sandra S. Gardebring
Executive Director

SSG:jw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